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GOVERNMENT OF INDIA

CENTRAL BOARD OF IRRIGATION

QUARTERLY BULLETIN No. 6.

APRIL TO JUNE 1937.

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SIMLA,
15th July, 1937.

RESEARCH COMMITTEE ANNUAL MEETING, 1937

Front Row. **Mr G A M Brown,** (N W F P) **Mr F F Haigh,** (Punjab) **Mr. C C Inglis,** (Bombay) **Mr Gerald Lacey,** (U P) **Mr M R Richardson** Vice-President (U P) **Mr G M Ross** President (N W F P) **Mr M T Gibling** (Secretary) **Mr A. R B. Edgecombe,** (U P)

Middle Row **Mr U S N Mahida** (Bombay) **Mr W J Benson** (Punjab) **Mr D N Sen Gupta** (Bengal) **Dr N K Bose** (Punjab) **R B Ajudhia Nath Khosla** (Punjab) **Dr E McKenzie-Taylor,** (Punjab)

Back Row **Mr H S Kahai,** (Sind) **Mr J K Malhotra,** (Punjab) **Mr H R Dogra** (Madras) **Mr A M R Montagu** (Punjab) **Mr W N McLeod,** (Punjab)

Office of the Secretary,
Central Board of Irrigation,
Simla, H. O.

QUARTERLY BULLETIN No. 6.

APRIL TO JUNE 1937.

The Board.

Rai Bahadur Bawa Natha Singh, Chief Engineer, Punjab, has retired from service from the first week of July and Mr. F. A. Farquharson, M.C., has been appointed in his place.

Mr. F. A. Betterton, Chief Engineer, Bihar, has proceeded on leave preparatory to retirement with effect from 18th May 1937, and Mr. G. F. Hall, C.I.E., M.C., is officiating until Mr. J. G. Powell returns from leave on the 16th of October next.

Mr. G. M. Ross, C.I.E., Chief Engineer, N.-W. F. P., and President of the Board, is proceeding on short leave in July and Mr. A. Oram will officiate for him.

The next annual meeting of the Board will be held in Delhi from 30th October to 4th November.

A meeting of the Executive Committee of the Board was held in Simla on the 24th of June, with Mr. G. M. Ross in the chair. The other two members of the Committee (Mr. Richardson, Vice-President, and Mr. Bedford, Member) were also present.

Research Committee.

The 7th Annual Meeting of the Research Committee of the Board was held in Simla from 21st to 24th June, under the chairmanship of Mr. G. M. Ross, President of the Board. The following officers attended :—

Mr. G. M. Ross, C.I.E., North-West Frontier Province. (President.)	Executive Committee.
Mr. M. R. Richardson, C.I.E., United Provinces. (Vice-President.)	
Mr. J. D. H. Bedford, Punjab. (Member.)	

Mr. Gerald Lacey, United Provinces.
Mr. A. R. B. Edgecombe, United Provinces.
Dr. F. McKenzie-Taylor, M.B.E., Punjab.
Mr. W. N. McLeod, Punjab.
Mr. F. F. Haigh, Punjab.
Mr. A. M. R. Montagu, Punjab.

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Rai Bahadur A. N. Khosla, Punjab.
Dr. N. K. Bose, Punjab.
Mr. J. K. Malhotra, Punjab.
Mr. W. J. Benson, Punjab.
Mr. C. C. Inglis, C.I.E., Bombay.
Mr. U. S. N. Mahida, Bombay.
Mr. H. S. Kahai, Sind.
Mr. H. R. Dogra, Madras.
Mr. G. A. M. Brown, O.B.E., North-West Frontier Province.
Mr. D. N. Sen Gupta, Bengal.

Mr. F. Anderson, C.S.I., C.I.E., Chief Engineer, Bahawalpur State, formerly Chief Engineer, U. P., and President of the Board for 1935-36, was present by invitation.

Dr. W. Burns, Officiating Agricultural Expert, Imperial Council of Agricultural Research, was also present during some of the discussions, by invitation.

The President, Mr. G. M. Ross, delivered the following speech at the opening of the meeting on the 21st June.

"GENTLEMEN,

It gives me great pleasure to have the privilege of presiding at this seventh annual meeting of the Research Committee of the Central Board of Irrigation. During the four years that I have been connected with the Board, I have learnt the immense value of the work being performed by this organization, and particularly by its Research Committee. This annual meeting affords a splendid opportunity for Irrigation Engineers from various parts of this country, who are particularly interested in research, to discuss both formally and informally the many problems which beset irrigation engineers, not only in India, but in other irrigating countries of the world. By constructive criticism of the various experiments in progress in those Provinces which have Research Stations, and discussion of other problems of common interest, we are afforded the best possible means of applying the combined knowledge and experience available in the country, to those problems which are so important to the many millions engaged in cultivation aided by irrigation. You are aware that India has a much greater area under irrigation than any other country in the world, and in fact, it is equal to the total area irrigated by the next five leading countries, including America. There is no need therefore for me to impress upon you the importance of this meeting, and the necessity for careful deliberation over the many problems before us. As the nucleus of irrigation research, in a country where irrigation has been practised over many ages, and has extended to such gigantic proportions, this Committee enjoys a world-wide reputation, and I trust that our business will be conducted with this in view. I am pleased that such a large number of officers have been able to attend this meeting, thereby creating a new record, which is proof positive that the value of this meeting is realized more than ever by Provincial Governments, and it is hoped that this interest will continue to grow. I extend a special welcome to those of you who are attending this meeting for the first time, and hope that you will return to your Provinces with knowledge which will be of benefit to your Governments, and the cultivators in your Province alike."

The following is a note on some of the experiments and other investigations undertaken during the year in the various Provinces conducting research, and some of the Committee's conclusions. Details of experiments are given in the Research Officers' Reports presented to the Committee (copies available in the office of the Central Board of Irrigation).

Provincial Research Officers' Reports, which were discussed, contained evidence of many useful experiments of far reaching importance having been undertaken.

In connection with land deterioration and reclamation, experiments in the Punjab Irrigation Research Institute show that much greater importance must be attached to atmospheric humidity as a cause of salt movement than was previously considered necessary. It has been shown that soils containing sodium salts can absorb a large amount of water from a humid atmosphere, and that this water is evaporated during the day under certain conditions with consequent salt movement. It appears that greater importance must be attached to the salts present in the soil profile than to those present in solution in the sub-soil water.

The Punjab alluvium consists of a soil crust of varying thickness over sand, and experiments indicate that waterlogging can only take place in which the soil crust is so thin that water can be raised from the water table in sand to the soil surface by capillary or other forces in sufficient quantities to lead to almost complete soil saturation.

The importance of a soil survey of the proposed alignments of new canals has been further substantiated by investigations carried out in connection with seepage from canals. If during the digging of a canal the soil crust is likely to be penetrated, then the seepage from the canal in that length will be excessive. Steps should be taken to change the alignment, if possible, in order to avoid such lengths, or to treat them by some means (*e.g.*, lining) in order to prevent excessive seepage.

In connection with construction and maintenance of kachha roads, methods have been devised for determining the effect of various treatments on the mechanical properties of soils.

Investigations on the design of weirs on porous foundations show that when there are two lines of sheet piling under a floor each of them is most effective in reducing the pressure when it is placed at the end of the floor. When, however, either of them is moved towards the centre of the floor its efficiency decreases. It is also found that the influence of one sheet pile is not perceptible on the other until they approach each other to within a distance which is about twice the length of either of them. Many of the works of this nature are provided with three lines of sheet piling, and it is found that if the intermediate sheet pile is about the same length as the end sheet piles or is shorter, it should be placed as near the centre as possible if it is to exert its maximum effect in reducing pressure. If the intermediate pile is longer than either of the end piles it will produce its minimum effect in reducing pressure if placed midway between the end piles. To increase its effect it should be moved towards either end

It was stated that an investigation has been in progress to determine whether it is possible to devise a method for detecting defects and cavities under weirs on sand foundations. The safety of this type of structure depends very largely upon the stability of the material underlying the weir. If cavities are formed and are not detected, the safety of the weir is at stake. The principle employed in the method under investigation is that wireless waves are partially reflected from any surface of discontinuity and when coming from different distances would reach an aerial in different phases. The composite reflected wave can be analysed by means of a cathode-ray oscillograph operated with a high-frequency time-base, and from the nature of the reflection it is possible to discover and locate any defects.

Water of various silt contents and various temperatures was used in order to ascertain the effect, if any, of silt and temperature on discharge measurements, and it was found that within limits of experimental error, variation in the temperature and the silt content of the water does not produce any appreciable difference in the discharge measured by a rectangular weir and a velocity meter.

The discharges of the Ravi river above Madhopur and the rain-fall data for Dalhousie were studied separately and jointly to discover the effect, if any, during the last 35 years, of the alleged denudation of the foot hills on the changes in summer and winter supplies. It was concluded that the floods were neither heavier nor more frequent in recent years, and that though there was no apparent tendency for the winter supplies to decrease, they needed to be carefully watched.

In order to study the effect of the rise of water-table and other factors on the various aspects of village life, histories of individual fields are being collected, together with other data, for 14 villages in the Sheikhupura District.

Experiments were carried out on models with the object of determining the form of protection to be adopted for the reduction of scour downstream of the Ferozepore, Islam and Balloki weirs. Experiments were also carried out in connection with the remodelling of Merala weir and the design of Trimmu weir for the Haveli Project. Designs for the construction of Jatli level crossing of the Upper Jhelum Canal were also examined. Models of several canal falls were studied in connection with downstream scour and side erosion.

It is concluded from experiments on the reclamation of Thur land that if the proper rotation of crops is adopted on land reclaimed from Thur there will be little decline in yield when the crops are grown on a zamindari water supply. The crop rotation that has been found most suited for reclaimed land is :—Berseem or Sanji, Sugar cane, Sugar cane (ratoon), Wheat and Cotton.

Aerial photography has been adopted to supplement ground surveys of areas affected by Thur as it has been difficult in the past to obtain a reliable survey with which the present Thur conditions could be compared. By means of aerial photographs it has been possible to distinguish Thur land which has never been broken, from land in which Thur has developed since irrigation commenced. The method will be of great value in recording rapidly the original and present conditions of irrigated areas.

During the initial stages of the development of an irrigation scheme a considerable portion of the water supplied is used in permanently increasing the moisture content of the soil profile, and when this maximum saturation of the soil has been reached it should be possible to reduce the water allowance without affecting the yield of crops or the intensity of cultivation. If the same water allowance is maintained, then the intensity of cultivation should increase.

Experiments carried out by the Research Officer, United Provinces, indicate that the application of sodium carbonate to canal beds can be relied upon to reduce losses by 35 per cent, for soils which contain more than ·098 per cent. of exchangeable calcium. The staunching effect is found to extend to a depth of one foot, and after six months from the time of application the staunching is still effective. Three methods of application have been tried and the cost varies from 0-5-6 to 0-14-10 per hundred square feet. Experiments are under investigation to ascertain the effect of treating canal beds with molasses in order to prevent seepage. The method has not been found very successful so far, but it is still under investigation.

Several types of devices for excluding excessive silt from canals are under investigation, and results are awaited, but it has been found that King's vanes have been found a successful device.

Experiments with a model to determine the most economical size of fall for the Karonnadi show that with a plain horizontal downstream floor a fall with a crest 200 feet in length with a depth of 16 feet is the most economical design.

The question of the use of coal tar for protecting steel work on hydraulic structures is under investigation.

The designs of flumed bridges and syphons were investigated with a view to cheapening the cost of construction.

The results of several interesting experiments on models at the Karachi Research Station were reported. Scour downstream of regulators and falls is a problem which calls for investigation by models, and as a result of the experiments, devices have been introduced which not only prevent further scour below the structures but also cause silting up of existing scour holes. In remodelling a regulator to be fitted with vertical screw gates in place of vertical "needles", a model was prepared to determine the effect of the change, and to suggest necessary alterations to control the high velocity jet if formed. The model proved useful in indicating the detailed alterations necessary to provide a successful structure. The old Bhagar Inundation Canal which takes off from the Indus River about 70 miles below Kotri has a number of bends in its total length of 90 miles. One such bend of 9 miles length was proposed to be eliminated by excavating a cut 3,000 feet long to a point in the canal where there is a drop of 19 feet from the bed of the cut to the scoured bed of the canal, and a regulator was proposed in the new cut. Due to its nearness to the sea, the regulator would come under the influence of tides, and it was decided to model the proposed design to ascertain what the downstream action would be and whether it would carry the required discharge without undue afflux, which would necessitate providing higher banks.

Another very interesting model experiment was carried out to ascertain the steps to be taken to provide an off-taking channel with the benefits of across regulator on the parent channel some distance above it. A divide wall was constructed in continuation of one of the piers of the regulator, connecting up with the downstream abutment of the off-taking head, and the gate in that bay of the cross regulator will be operated so as to discharge the correct quantity into the off-taking channel. The question of silt draw was also investigated.

Experiments are also in hand with the treatment of canal beds with sodium carbonate to reduce seepage losses.

Important investigations in connection with sub-soil drainage have been carried out in Sind, the results of which will be of considerable value in the Board's examination of the drainage problem, in connection with which the Research Committee framed a questionnaire. A study of the data available from sub-soil water investigations shows that the spring level in Sind is more or less steady.

In the areas investigated it has been found that sub-soil water which had a high salt content before the opening of the Lloyd Barrage Canals, has become diluted to some extent since the introduction of perennial irrigation. The continuation of these investigations are important where the water table is high or rising, in order that steps may be taken, if found necessary, to prevent rise of the water table close enough to ground surface to permit of damaging land by salts drawn up by capillarity and other forces.

A number of interesting experiments were carried out during 1936-37 at the Hydrodynamic Research Station at Khadakvasla near Poona. This Station is being financed by the Government of India during the present financial year pending decision as to whether an all-India research station for Irrigation is necessary, and if so, where it should be located, and the nature of work to be carried out. Bombay Government maintained this Station up to the end of last financial year but with the separation of Sind they were unable to continue to finance it, and it was proposed that it should be continued as a Central station financed by either the Central Government or by contributions from Provincial Governments and other bodies such as the Railway Board.

The work carried out last year included several river training problems, and others connected with storage reservoirs, canal falls, etc.,

In 1920 a causeway was constructed across the Sina River 5 miles from Ahmednagar on the Mannad Road, and since then the river has been scouring out the right bank to such an extent that it was feared that the causeway would be outflanked. Two masonry groynes and a flank wall were constructed in 1929 with the object of diverting the river to its original bed, but without success. A model of the site was constructed and investigations on it showed that the groynes only deflected the low velocity bed water and accentuated the erosive action of the high velocity top water. It was found that the difficulty of scouring could best be overcome by making a cut through the projecting nose on the left bank of the river just above the causeway.

A new high level causeway was built across the Mula River at Rapuri in the Ahmednagar District in 1922, and the existing ferry was shifted about 500 feet upstream, but it was found that the river currents made use of the ferry unsafe. A groyne was constructed in 1929 to divert the high velocity current from the landing stage, but it did not materially improve matters. After testing out several proposals on a model, it was found that the solution lay in the construction of 5 groynes pointing upstream.

From a working model of the Bhimgoda Weir across the Ganges at Hardwar in the United Provinces it was ascertained that the best method of protecting the Weir downstream of the undersluices was to provide a "baffle" and a "deflector". As it was feared that any such device would be damaged by boulders which are washed down the river, or that they would be trapped, pebbles were used in the model to represent boulders in the river, and it was found that they were washed over the baffle, and presented no difficulty.

The reservoir at Bhandardara (Lake Arthur Hill) at the source of the Pravara River is provided with a waste weir to carry off surplus water in order to prevent the dam from being over-toped. By improving this waste weir it will be possible to discharge a full flood when the necessity arises, but at the same time, the level of it can be raised, thus enabling a large quantity of water to be stored in the reservoir. Owing to the large area of the lake at full supply level, which is the spilling level of the waste weir, a few inches extra in depth will provide a very large quantity of extra water which can be utilized in expanding the area under irrigation. By means of models the correct discharging capacity of the spillway as it exists has been ascertained, and experiments are now in hand to enable a suitable profile for the weir to be designed.

Experiments with a large scale model of the Hardinge Bridge over the Ganges are still in progress, and a similar problem, namely, training the river above the Sarda Barrage at Banbassa, United Provinces, is also undergoing investigation. One branch of the river above the Barrage tends to swing across the face of the Barrage and is liable to create serious conditions.

Experiments on guide banks for bridge protection and falling aprons for embankments are still in progress for the Railway Board. From experiments on canal falls some important conclusions have been reached.

A number of important experiments were carried out on soil and irrigation research by the Irrigation Research Division at Poona and Baramati comprising the study of typical soil profiles, the physico-chemical changes caused by irrigation and high sub-soil water levels, and the reclamation of soil tilth of damaged lands after drainage. It has been found that irrigation damages some types of soil whereas it is beneficial to others, the depth of the sub-soil water being an important factor, thus showing the necessity for a careful soil, and sub-soil water table survey in areas to be brought under irrigation.

Experiments with Gypsum, Sulphur and Lime for improvement of soil tilth showed that in a field of sugar cane, Gypsum is of considerable value, whereas Sulphur and Lime are of little benefit.

For damaged soil, several varities of cane were grown for comparison of yield,—CO 212 and CO 285 being the most successful.

Dhaincha was found most suitable as a green manure, and *Nilva* proved to be the best fodder crop. *Dhaincha* reduces sodium and alkalinity in the soil more effectively than Sann Hemp but the latter nitrifies the soil more rapidly than the former.

Sewage effluent from the Poona Drainage Improvement Scheme has been used since 1929 by passing it down canal distributaries for use with irrigation water in certain areas suitable for the purpose. As the quantity of effluent has increased more than ten times in the past five years there is difficulty now in disposing of it in the limited area available. In order to ascertain the maximum quantity that can be utilized in this manner, experiments have been carried out to determine the maximum dose applicable to sugarcane, and the varieties of cane most suitable for this treatment.

In connection with the discussion on the seepage of water from canals and the means to prevent it, it was decided that the method of applying sodium carbonate to the bed of a canal containing a quantity of calcium clay, is a cheap and effective method of rendering the canal bed less pervious. The best method of application appears to be the broadcasting of the dry material on the surface after removing one foot of material from the bed, and then replacing it. The most efficient rate of application of the sodium carbonate is found to be 100 lbs. per 1,000 sq. ft. of surface treated.

The design of canal falls is a subject which has received considerable attention by the Board and its Research Committee for several years, but it has not yet been possible to specify any one type of fall which answers all purposes, and the question of preparing type designs is still under consideration. A number of experiments have been carried out at the Hydrodynamic Research Station at Poona in accordance with the suggestion of the Board, and some interesting results have been obtained. These results were brought to the notice of the Committee by Mr. Inglis, and it was stated that some of the designs had proved successful on models and also on works in Sind. Mr. Inglis' complete report on the subject is not yet ready, but it is hoped that it will be ready in time for examination by the Board at its next meeting at the beginning of November. The Committee is of the opinion that until comprehensive research has placed the principles of design beyond dispute it is inadvisable to record a recommendation in favour of any type design for general application.

During the discussion on the Questionnaire on "Conditions predisposing to harmful soil saturation which may ultimately result in waterlogging" it was decided that as the conditions in various Provinces varied to a considerable extent, and prevented the framing of replies to questions to meet all conditions the Provinces should reply to the questions separately, in order that the various conditions prevailing in Provinces may be compared.

In connection with the meandering of rivers, it was stated that rivers appear to meander more in equatorial regions than in the polar regions, and the reason for this phenomenon, if ascertainable, would probably throw some light on this problem which is of considerable concern to all Provinces. It was considered that distinction should be made between meandering and tortuosity. The question of providing cuts in order to shorten tortuous rivers was discussed at length; the advantage of this method is highly problematic. On the Mississippi and Missouri Rivers in America the problem of flood control has been dealt with in some areas by providing cuts, and in others by constructing levees (embankments).

Prior to discussion of the questionnaire on Land Reclamation there was a short talk on Air Surveying, and photographs were exhibited of areas affected by salt which had been photographed in order to provide an accurate and complete record of the areas so affected. It is proposed to introduce a periodical survey by this means in order to maintain a record of the affected areas and to ascertain whether there is any increase or decrease in the area. Examples of river surveys by aerial photography were also exhibited, and it was seen that they would be of considerable value in river training and harbour problems.

In connection with the design of weirs on permeable foundations it was stated that the publication dealing with this problem, which has now been completely solved, will be issued shortly by the Board. A new subject to be taken up for discussion at next year's meeting is that of silt excluding and ejecting devices for canals.

A group photograph of the officers attending the Research Committee meeting is reproduced in this Bulletin.

Board Publications.

Revised edition of "Glossary" (Pubn. No. 5) is still under preparation, as replies from some officers have not yet been received.

"Design of Weirs on Permeable Foundations" (Pubn. No. 12) is still in the press, but is expected to be issued shortly.

Annual Report (Technical) of the Work of the Board for 1935-36 (Pubn. No. 14) was distributed during the quarter.

The Research Committee passed a resolution recommending that Mr. Gerald Lacey should be placed on special duty to write up his publication on the design of canals in alluvium.

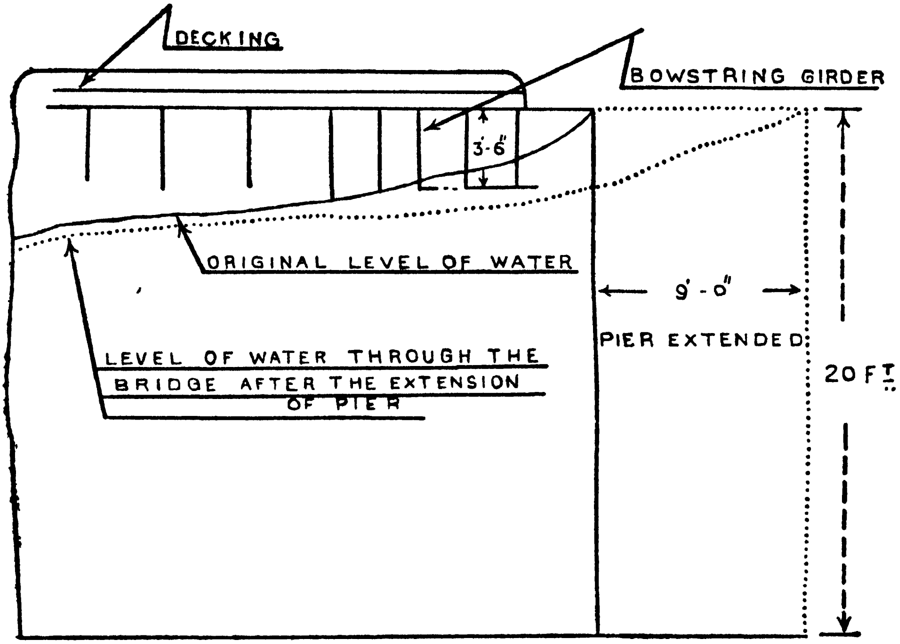
Works Section.

MADRAS.

Works of a Novel Character constructed at the Mettur Dam.

Due to the contraction of the waterway at the site of the bridge over the channel from the sluices at Mettur, there was considerable velocity and afflux whenever full supply (28,000 cusecs) was discharged, with the result that the water hit the bow string girders of the bridge. The piers on the upstream side were lengthened by 9 feet and built to a lenticular shape. This alteration shifted the point of afflux sufficiently upstream to ensure that the girders cleared the water. The old piers and the extensions are shown in the diagram below.

2. At the same bridge considerable disturbance due to eddies was observed in the triangular pockets where the sloped revetment met the vertical wall of the bridge abutment. The revetment was removed in a length of 75 feet and replaced by a wall designed to give a smooth stream-line connection between the vertical abutment and the 1 : 1 revetment. This alteration has had the desired effect; the flow is now smooth.



(NOT TO SCALE)

PUNJAB.

Dadupur Silt Excluder, Western Jumna Canal.

The Dadupur Silt Excluder was constructed during the early part of 1936 and was opened in June of that year.

Its object is to stop or reduce the progressive silting which is taking place in the Main Line Lower and Main Branch of the Western Jumna Canal. It comprises four tunnels averaging 7·5′ × 3·5′, taking approximately the lower one-fifth of the water approaching the canal regulator, the canal capacity being 6,400 cusecs.

A unique feature of the design is that water enters the tunnels through an orifice 1′ high which is continuous across the bed of the canal. Uniform distribution and loss of head is secured by the use of 36 curved reinforced concrete vanes situated in this opening.

The photographs on the opposite page show the downstream tunnel portals with their gate control, and the canal regulator with the excluder abutment on the left.

Information Bureau and Library.

It is brought to the notice of readers of this Bulletin that it has been arranged to keep the Library of the Central Board of Irrigation at Simla open to 7-30 P.M. on all days except Sundays and other closed holidays, with effect from 12th July, so that it may serve as a reading room for officers who are in Simla during the summer season, on duty or otherwise. Recent periodicals and other literature will be available for perusal.′

The following are some of the enquiries dealt with during the quarter under review :—

Staunching of canals with particular reference to the method of applying sodium carbonate.

Lacey theory for the design of canals.

Standard methods for testing materials for earthen dams.

Tube Wells.

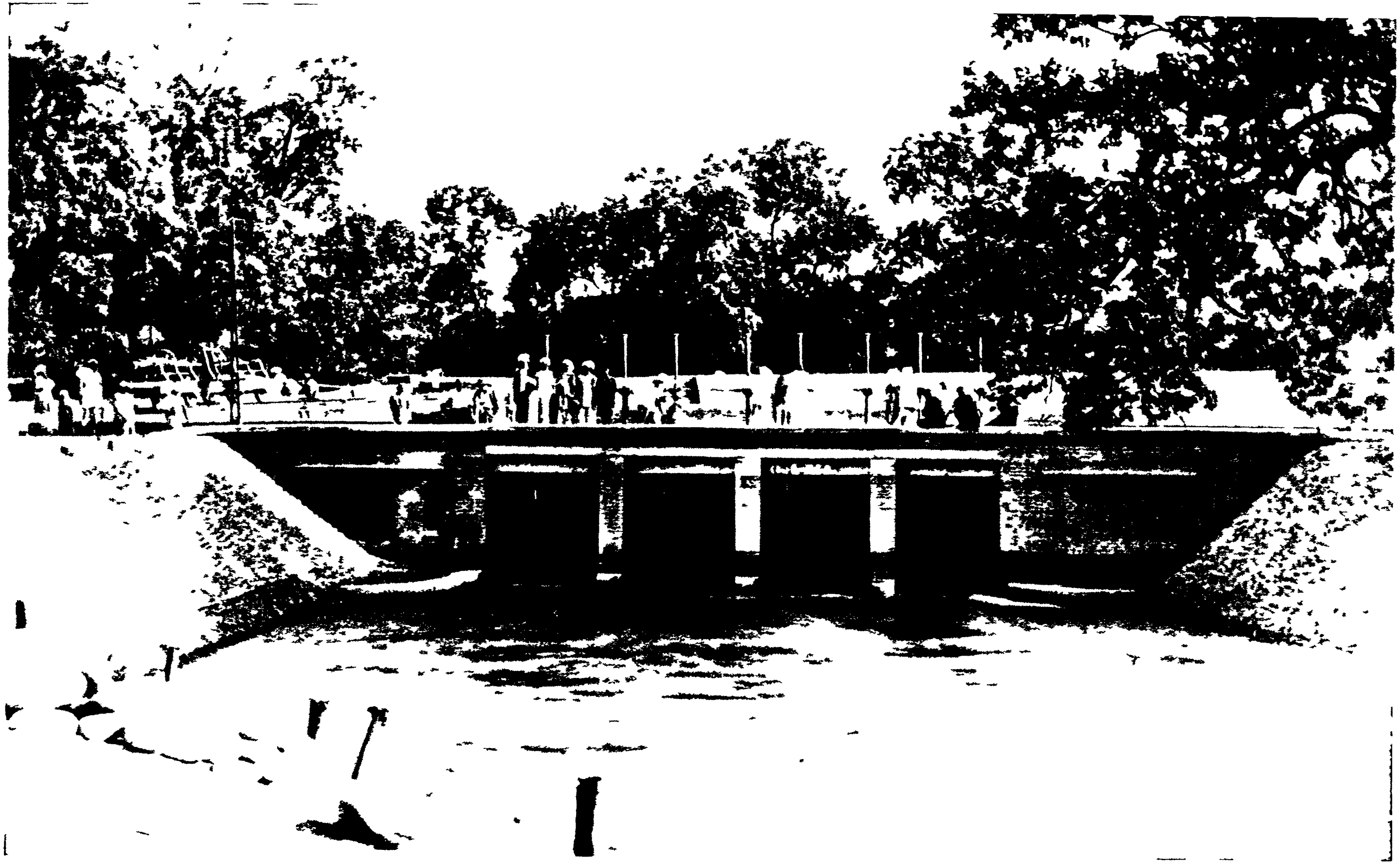
Air conditioning of buildings.

Reinforced concrete arch bridges.

Experiments on canal falls.

Replies to the Questionnaire on "Meandering of Rivers", which was circulated to Members of the Board, Railway Board, and a few others during the last quarter, have been received from some officers. The Questionnaire will be discussed at the next Board meeting.

DADUPUR SILT EXCLUDER



Downstream Tunnel Portals with their gate control.

The following is the programme for 1937-38 of the Hydrodynamic Research Station (Khadakvasla) near Poona, which is being financed by the Government of India for one year from the 1st of April last :—

The programme is split up into

I. Specific experiments, and

II. Basic Research.

SPECIFIC EXPERIMENTS.

Experiments on behalf of the Railway Board in continuation of last year's experiments.

1. Experiments with the extended 1/500 scale model of the Ganges and the Hardinge Bridge for investigating the movements of the River. This is a long series which will continue throughout the year.

2. Experiments with (1/2000 scale) small model of the Ganges for determining fundamental laws for reproduction of Rivers in small models.

3. Pier experiments for protection with stone pitching against scour.

4. Guide Bank experiments to show action of falling aprons and best methods of protecting guide banks on this principle.

5. Subsidiary experiments such as effect of clay belts on scour downstream of piers in 1/500 scale model; effect of size and shape of stones on scour round piers.

Fall Experiments for the Central Board of Irrigation (in continuation of last year's experiments).

6. Experiments with low falls.

(*i*) standing wave flume meter fall.

(*ii*) plain weir fall.

(*iii*) weir falls with glacis, arrows and control blocks.

(*iv*) weir falls with glacis, baffle, cistern and deflectors.

Experiments for the U. P. Government.

7. Training of the River Sarda at Banbassa.

8. Methods of preventing scour and protecting the floor downstream of the Sarda Barrage.

9. Experiments with a model of the Ganges River and Canal Head works at Hardwar.

Experiments for Sind.

10. Experiments with a model of the Sukkur Barrage to prevent silting near the right bank upstream of the Barrage.

11. Reduction of scour at bends.

Experiments for the Baluchistan Government.

12. Model experiments on waste weir of the Spin Karez Reservoir Project.

Experiments for the Central Provinces Government.

13. Uplift pressures in submersible bridges.

Experiments for the Government of Madras.

14. Silt exclusion experiments with vanes.

15. Design of baffles and deflectors for an apron downstream of anicuts and regulators.

16. Reducing afflux in the Krishna Right & Left Bank Head Works by bellmouthing upstream, and expansion downstream.

Experiments for the Central Government.

17. Training of the River Jumna at Delhi.

Experiments for the East Indian Railway.

18. Experiments with piers of Lower Sone Bridge.

Experiments for the Government of Bombay (Deccan).

19. Experiments with model of the Godavari Right Bank Head Regulator to reduce scour downstream.

20. Experiments with models of the waste weir of Lake Arthur Hill (Bhandardara), in connection with raising the weir to increase the tank contents.

21. Experiments with a model of the Sina River and causeway on Nagar-Manmad Road.

22. River training experiments of Mula River at Rahuri.

23. Experiments with a model of Aqueduct No. 3 of the Girna Canal to prevent scour downstream.

24. Training the Nala upstream of Aqueduct 6 of the Nira Right Bank Canal to prevent silting.

25. Training the Nala upstream of Aqueduct 12 of the Nira Right Bank Canal to prevent silting.

BASIC RESEARCH.

26. Investigation of bed movement of various types of sand, and silt under controlled conditions.

27. Meandering of Rivers.

28. Laboratory experiments to determine factors affecting losses from Canals.

29. Experiments to determine the merits and demerits of various types of spurs.

30. Scale effect of rigid structures and guide banks on model slopes.

31. Weir experiments to ascertain maximum coefficient.

32. Experiments for B. D. V. relationship in expansions.

33. Continuation of experiments to show effect of scale on scour.

34. Experiments with Canal culverts to reduce afflux.

35. Experiments with head regulators to ascertain factors causing loss of head and scale effect of model.

36. Experiments with standing wave flume

(a) to observe the effective head due to velocity of approach with upstream channels of various shapes.

(b) to find the effect of depth upstream of the hump on coefficient, keeping the width of the upstream channels constant.

(c) to find the optimum position of the upstream gauge.

(d) to find the effect of the throat length and sloping glacis downstream on coefficient.

37. **Venturi flume experiments.**

To produce best type designs and calibrate them (continuation of last year's experiments).

38. Experiments with the modified design of the Crump Adjustable Proportional Module to find the minimum modular head.

MISCELLANEOUS.

The United Provinces have adopted the Lacey theory for the design of channels in alluvium and several channels have been constructed or remodelled in accordance therewith. It is too early at present to say whether those channels have proved satisfactory, but where the theory has been properly applied, there is no case of it having proved unsatisfactory, and the results are promising.

The following extract from the Administration Report of the P. W. D. (Irrigation Branch), Burma for 1935-36, shows the results obtained by widening the Ye-U canal according to the Lacey theory :—

"The Ye-U Canal, which is on the convex side of the river, silts up very rapidly. It was unsilted in 1922 and again in 1927. On each occasion the bed was unsilted to its designed bed width and bed level. In 1936 it was decided to widen the canal to a section conforming with the principles expounded by Lacey of the United Provinces, and to leave the bed silt undisturbed. This was done with gratifying results. The maximum discharge secured at full supply level has been 1692 cusecs, a discharge much in excess of that secured in 1922 and 1927, and at a much smaller amount of expenditure."

The newspapers report that the Sind P. W. D. have now under investigation a hydro-electric scheme under which it is proposed to generate electricity at the Tando Mastikhan Fall on the Rohri Canal where there is a fall of 8′ and a discharge of about 10,600 cusecs. The scheme is estimated to cost 10 lakhs, and will probably supply energy to Sukkur, Rohri and other neighbouring towns, and meet the demands of the new cement factory to be erected at Sukkur. The details of the project will be worked out by the Chief Electrical Engineer in Sind. If the required financial resources are available the scheme will be launched by Government; if not, it will be left to private enterprise.

Proceedings of the 2nd International Congress on Large Dams, which was held in U. S. A. in 1936, will be available for sale very shortly. The Proceedings consist of 5 volumes, Vol. I—General description of the Congress, General Reports, Resolutions and Index, Vol. II—Reports and Discussions on Question No. 3 (Special Cements); Vol. III—Reports and Discussions on Questions Nos. 4 and 5 (No. 4—Design and Water proofing of Shrinkage Contraction and Expension Joints; No. 5—Study of the Facing of Masonry and Concrete Dams); Vol. IV—Reports and Discussions on Questions Nos. 6 and 7 (No. 6—Geotechnical Studies of Foundation Materials; No. 7—Calculation of the Stability of Earth Dams); and Vol. V—Communications on (1) Experimental methods for insuring the safety of gravity dams, in particular by the study of internal pressure, (2) Study of dams built of precast concrete blocks with special reference to the avoidance of setting stresses in mass concrete, (3) Dams built by depositing stones in running water, and (4) What are the best means of preventing "piping"? Complete sets of the Proceedings will be available for approximately 58 rupees (500 francs) excluding customs duty, transport and other charges, if ordered before 1st August 1937, otherwise 600 francs. Individual volumes are priced separately—Vol. I, 110 fr.; Vol. II, 95 fr.; Vol. III, 120 fr.; Vol. IV, 160 fr.; and Vol. V, 110 fr. There will probably be a rebate of 33 per cent. if the volumes or complete sets are ordered through this office.

The following officers of the Irrigation Departments of the various Provinces received the honours noted against them on the occasion of the Coronation of His Majesty the King Emperor George VI :—

G. M. Ross, Esqr., B.A.I., I.S.E., Chief Engineer and Secretary to Government of N.-W. F. P. in the Public Works Department. (President of the Board for 1936-37).	C. I. E.
Khan Bahadur Maulvi Abdul Aziz, I.S.E., Superintending Engineer, P. W. D., Irrigation Branch, U. P.	C. I. E.
H W. Oddin, Taylor, Esqr., O.B.E., A.C.G.I., A.M.I.C.E., I.S.E., Superintending Engineer (Irrigation) and Joint Secretary to the Hon'ble the Agent to the Governor General in Baluchistan in the Public Works Department.	C. B. E.
Captain A. E. Green, M.C., A.M.I.C.E., I.S.E., Temporary Superintending Engineer, Bihar.	O. B. E.
Mr. Manmatha Bhushan Datta, Subordinate Engineering Service, S.D.O., Irrigation Department, Bengal.	M. B. E.

Mr. Dhanapati Mondal, Overseer in the Irrigation Department, Bengal.	Kaiser-i-Hind Medal (3rd Class)
Lala Devi Singh, Executive Engineer, P. W. D., Irrigation Branch, Punjab.	Rai Bahadur.
Rao Sahib Narayan Ramchandra Joshi, Bombay Service of Engineers, Asstt. Engineer, Belgaum Division, Bombay.	Rao Bahadur.
Babu Narendra Nath Das, Offg. Executive Engineer, Burdwan Division, Bengal Presidency.	Rai Sahib.
Babu Jogendra Shankar Dhar, Assistant Engineer, Irrigation Department, Bengal Presidency.	Rai Sahib.
Lala Kanwar Sain, Executive Engineer, P. W. D., Irrigation Branch, Punjab.	Rai Sahib.
Beli Ram Malhotra, Esqr., B.Sc., Asstt. Engineer, P. W. D., N.-W. F. P.	Rai Sahib.
Lala Harchandi Lal, Asstt. Executive Engineer, Central P. W. D.	Rai Sahib.
M. R. Ry. Krishna Ayyangar Srinivas, Offg. Assistant Engineer, P. W. D., Madras Presidency.	Rao Sahib.

Preliminary work on the Haveli Project in the Punjab is expected to commence next cold weather. Mr. F. F. Haigh has been appointed Superintending Engineer of the First Haveli Circle, and Rai Bahadur Ajudhia Nath Khosla is to hold charge of the Headworks Division at Trimmu. A special Designs Division has been formed under the control of the Chief Engineer (Construction), and Rai Sahib Lala Kanwar Sain has been appointed to it.

Alternative designs of the proposed Weir at Trimmu are being modelled and tested at the Research Institute in Lahore.

Mr. A. M. R. Montagu, the former Secretary of the Central Board of Irrigation, has been placed on special duty to investigate the possibility of introducing Tube Well irrigation in the Punjab on a large scale.

The Punjab Waterlogging Board decided at a recent meeting that aerial photography is a suitable means of making and recording an accurate survey of salt affected land, and recommended that surveys should be made periodically by this method. in order to ascertain the areas, if any, in which the trouble is spreading.

The Thal Canal Project in the Punjab is undergoing further investigation, with a view to presenting the scheme to the Legislature for consideration, in the near future.

Preliminary work has been undertaken in connection with the Tejewala Headworks. Western Jumna Canal, Punjab, where it is proposed to remodel the gates of the undersluices on the right bank during the coming winter.

There is a proposal to provide a line of sheet piles downstream of Islam Weir, Sutlej Valley Project, Punjab.

Literature.

The following literature was received in the library during the quarter under review :—

Readers are reminded that they are at liberty to borrow any of the literature in the Board's Library, in accordance with the rules published in Bulletin No. 3, and to submit enquiries on any matter dealing with irrigation and allied subjects.

PERIODICALS.

CIVIL ENGINEERING AND PUBLIC WORKS REVIEW.

Vol. XXXII.

No. 369—March 1937.

THE ZILLERBACH DAM.

This dam impounds water for the supply of the town of Wernigerode. It is of concrete gravity type and the principal dimensions are : length of crest 570 ft. ; height 154 ft. ; width at base 105 ft. There are expansion joints at 40 ft. intervals, and a waterproofing layer 4 ft. thick on the upstream face. The expansion joints cut straight through the dam, and are sealed by copper sheets situated 2·6 ft. from the upstream face. The copper sheets are ·08 in. thick and 2·8 ft. wide. At the centre of the copper plate there is a 4 in. fold to allow for movement between the blocks. and these folds are embedded in asphalt. The concrete surface at the expansion joints was given a ·12 in. coating of bitumen.

WIDENING RICHMOND BRIDGE

Describes the method of chemical consolidation to be used in the foundations. The existing piers are supported on timber rafts resting on the gravel bed of the river and enclosed by timber piles. The first stage in the extension of the piers will consist of driving to the London clay a steel sheet pile cofferdam around each pier. Excavation will then be carried out down to the level of the lower surface of the timber raft. A series of grouting holes will then be drilled 2 ft. apart, from the bottom level of the raft to the London clay, and chemical consolidation will be carried out by the "Joosten" process. By this means, a wall of consolidated gravel 4 ft. thick will be formed round the periphery of the pier extending from the underside of the timber raft to the London clay.

THE LATERAL FORCES ON STANCHIONS IN SINGLE STORY BUILDINGS. Voce.

This is the fourth of a series of articles on the subject and deals with the calculation of bending moments due to lateral forces on stanchions when they are all main stanchions, the internal stanchions have large spacings and bracing is not provided.

COAST PROTECTION WORKS IN LINCOLNSHIRE. Haynes.

The tides of the river Humber have been encroaching upon the Lincolnshire shore to the west of the outfall of the river Ancholme into the Humber. Hundreds of acres of fertile land have been washed away. Flood banks were erected by landowners for protection of the shore but these were found to be ineffective. A road which runs parallel to the foreshore and near it became endangered in 1935, and the Catchment Board concerned advanced for consideration a scheme of stabilizing the shore line with brushwood mattresses and stone. The first part of the scheme is intended to protect the underwater slopes of the bank. A series of eight strong points are being constructed extending to the river bed. The footings of these strong points consist of groups of brushwood mattresses 2 ft. in thickness extending from low water spring tide level to the river bed, sunk and weighted down with stone. These are finally covered with about half a ton of stone per square yard. Special slag pitched buttresses will then be laid on the slope above the low water mark up to the existing stone pitching of the road embankment. The base line and sides of the buttresses will be held by sheet steel piling. The procedure of making the mattresses and sinking them in position has been described in some detail.

NEW BRIDGE IN LATVIA.

Describes a recently completed Bridge in Latvia. It consists of 3 main spans of 82·5 m each and is designed for railway and highway traffic. The girders of the main spans are of the Warren type. An interesting feature in the design of the main spans is the elimination of secondary stresses by predistortion of the steelwork. In the fabrication of the steelwork, the lengths of the members were increased or decreased by amounts equal to the increments or reductions in their lengths developed under full load conditions.

BUILDING SCIENCE ABSTRACTS.

CEMENT SETTING TEMPERATURES. Santarella.

The Author presents a report on tests carried out on neat cements, mortars, and concretes with a view to determining the relationship between the heat of setting, the type of cement used, and the mechanical properties of the hardened products. The cements were tested both when fresh and after storage. One general conclusion from the investigation is that for any given cement the lower the temperature of setting, the lower the strength. Moist curing is the most satisfactory method as regards strength development.

PENETRATION OF MOISTURE INTO MASONRY WALLS.
National Bureau of Standards, T. N. B. 1936 (234).

Describes tests of the rate of penetration of moisture through masonry walls. Water was applied by means of a spray at the top of the wall to simulate rainfall. Measurements were made of the time for dampness to appear on the unexposed surface. The results of the tests are discussed.

No. 370—April 1937.

NOTES OF THE MONTH.

THE INSTITUTION OF ENGINEERS (INDIA).

Comments on the annual report of the Institution of Engineers (India) for the year ended August 31, 1936. Membership increased by 79. The Institution continued to act as the Indian Committee of the British Standards Institution. His Excellency the Viceroy's prize was awarded to Mr. G. Bransby Williams for his paper on the design of masonry gravity dams.

FOREIGN NOTES.

In V. D. I. Zeitschrift 81, 29, G Mussgnug discusses the action of the various substances which are added to Portland cement clinker to control the time of setting. Ordinary Portland cement is very rapid setting unless a delaying agent is present. This is usually some form of calcium sulphate.

MODERN SUSPENSION BRIDGES. McConnel.

For bridges of spans in excess of 1,000 ft., the suspension type is more frequently used than any other type. This type of structure is not confined however to large spans and for spans not exceeding 100 ft., foot bridges and pipe line structures can be built of this type economically, while for light highway bridges it can be advantageously used for spans as short as 150 ft. Outstanding examples are confined to America, and a large number have also been built in France and the French Colonies. This type has however been undeservedly neglected by British engineers on the ground of its lack of rigidity, which may be a factor to be considered in railway work but does not affect highway work. Some advantages of this type of bridge are described. Features of the older types are discussed. In the earliest suspension bridges, chains of wrought iron links were used for suspension. Improvement in wire ropes during recent years has resulted in the universal adoption of the wire rope for suspension. A general description of some modern bridges of this type in America, and the Continent of Europe is given, and American and Continental practices are compared.

THE LATERAL FORCES ON STANCHIONS IN SINGLE STORY BUILDINGS. Voce.

Continuation of articles in previous issues. A number of examples are worked out to illustrate the methods used to calculate bending moment and deflexions, etc.

BUILDING SCIENCE ABSTRACTS.

THE DETERMINATION OF COMPRESSIVE STRENGTH AND HEAT EVOLVED BY CONCRETE IN THE INTERIOR OF LARGE MASSES BY MEANS OF THE THERMO-ELECTRICAL CALORIMETER. Honigmann.

Paper presented at the Second Congress on Large Dams. A new highly sensitive calorimeter without heat capacity for the exact determination of the heat given out by the concrete, and its uses for the determination of compressive strength in the interior of large concrete masses are described. The heat evolved per unit of time during hardening depends on the proportion of the mix, the water added, the atmospheric temperature prevailing, and the hardening pressure. The compressive strength is also primarily dependent on the same factors and therefore there is a close connexion between heat evolved and compressive strength.

SOIL EROSION. Roscamp.

In this article attention is drawn to the serious losses caused by erosion, and some measures to combat this evil are indicated. From experiments made it has been found that for a given number of gallons per acre of rainfall, bare plots lose 56,222 lbs. of soil per acre, cotton plots lose 37,745 lbs. per acre, corn plots 13,152 lbs. per acre and Bermuda grass plots only 262 lbs. per acre. Results of tests show that provision of vegetable cover is the most effective method of dealing with the problem of erosion. The three general principles to be observed are given as (1) the encouragement of ground cover (2) the leveling of sites and (3) the construction of barriers to stay the velocity of water run-off. If erosion is left uncontrolled in the higher reaches of a river watershed, the usefulness of large dams and hydro-electric works in the lower reaches becomes questionable.

No. 371—May 1937.

THE INTERNATIONAL CONGRESS OF THE INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

Editorial review of the International Congress held in London from April 19 to April 24. Over 200 papers by leading authorities of 20 countries were presented before the Congress. More than two thirds of these dealt with metals or inorganic materials. All the papers indicate the rapid rate at which research work is advancing the knowledge of materials. In no field perhaps is more investigation being carried on than into the properties of concrete, plain and reinforced. 43 papers were presented on this subject. The subjects dealt with in the papers include: Strengths of concretes and cements under various conditions of temperature; the accelerated ageing of a sample by the passage of an alternating current through it; and the vibration of concrete. The accelerated ageing of samples may open up new possibilities in carrying out a test equivalent to a 28 day test in about 24 hours after preparation of the sample.

NOTES OF THE MONTH.

FENLAND FLOOD ALLEVIATION.

Dr. Schoenfeld, Director General of Inland Waterways of Netherlands, was invited to make an examination of the flood control methods in use in the Fenlands. The cause of recent floods in the Fenlands may be ascribed to heavy rainfall, high tides, and a north-east wind. The high sea levels caused by spring tides and north east winds result in a considerable backing up of the rivers along the lower reaches, causing floods. Dr. Schoenfeld suggests the construction of a suitable outfall sluice at a point near the mouth of the river. This would avoid overtopping the banks at high tide, but adequate storage for maximum run-off over the catchment would be necessary. A second alternative suggested is the construction of a barrage across the Wash. The area of the Wash cut off from the sea by the barrage would serve as an immense flood storage reservoir which could be discharged through sluices at suitable states of the tide. The work however presents serious difficulties besides being a very costly undertaking. The maximum depth of water in which work would have to be done is about 100 ft. and the tidal range is 22 ft.

FOREIGN NOTES.

LARGE SCALE VIBRATION OF CONCRETE.

In *Le Genie Civil* 158, 110, W, the use of a mechanical vibrator specially constructed for the slopes of the inlet canal of the Champaubert Reservoir in the forest of Der in France is described. The canal is over 3 miles in length and has a bed width of 13 ft. and depth of 6 ft. The bed and slopes will be concreted with 6 inch depth of concrete. The concrete was vibrated with a specially designed apparatus which is described.

THE NEW DOG IN A DOUBLET BRIDGE.

Harper.
Hill.

Describes the detailed design of a new reinforced concrete bridge at *Dog in a Doublet.* The bridge consists of three spans of reinforced concrete flat slab construction. The two side spans are 60 ft. while the centre span is 100 ft. The centre span is composed of two 30 ft. cantilevers supporting a central suspended slab of 2 ft. 6 inches thickness. The cantilevers are 5 ft. 6 in. thick at the supports and are cast monolithic with the end spans of 60 ft. The joint between the cantilever and suspended slab is of the halved type and is ½ in. thick throughout. Compound plates of ¼ inch steel and ¼ in. phosphor bronze are fixed to both the suspended span and the cantilever and set ¼ inch into the concrete and fixed by means of rag bolts. The piers are founded on 14 in. by 14 in. reinforced concrete piles 26 in number. The end supports consist of 3 ft. wide by 2 ft. deep rectangular pile caps resting on five 14 in. by 14 in. reinforced concrete piles. Details of calculations for the design are given.

FOUNTAIN WORK AT LEICESTER: STRENGTHENING A BRIDGE ABUTMENT.

An interesting and unusual method of strengthening a bridge abutment is described in this article. The bridge in question is a single span wrought iron arch bridge with brick abutments out over a canal. The span is 74 ft. Cracks of a serious nature occurred on one abutment. An examination of the cracks indicated that the abutment had sheared along a horizontal plane below the sandstone bearing blocks. There was no indication of settlement having taken place, and the movement was entirely horizontal. The essential features of the reconstruction scheme were: the strengthening of the abutment brickwork by grouting and the insertion of dowels; and construction of three pressure piles behind the springing of each arch rib at the east abutment, the tops of the piles being incorporated in a reinforced concrete slab resting on the top of the abutment brickwork. The arrangements and details of work are described at length with several illustrations.

THE LATERAL FORCES ON STANCHIONS IN SINGLE STORY BUILDINGS. Voce.

Continued from previous issue. In the present article, the author deals with the computation of wind and other loads on stanchions in a complicated structure.

IMPROVEMENTS TO THE RIVER REA, BIRMINGHAM.

Describes some features of the work of improving the channel of the river Rea near Birmingham. The work consists of deepening the masonry invert of the river by 4 ft. in a length of 1170 yards. This lowering of the river bed necessitated underpinning of one road bridge, a viaduct, a culvert underneath a railway goods-yard, and an aqueduct. The methods adopted for underpinning are described in brief.

BUILDING SCIENCE ABSTRATTS.

Waterproofing bridges and other structures: *Wasserund Wagebau-Zeitschrift*, 1936, 34(11). The use of a synthetic product resembling rubber, in the form of fabric and of adhesive dressing on some bridges in Germany is described. Waterproofing of a bridge by means of sheets of a special copper alloy is also described.

CONCRETE AND CONSTRUCTIONAL ENGINEERING.
VOL. XXXII.

No. 3—March 1937.

THE MODULAR RATIO—III. Hajnal-Kónyi.

The third and final article on the new method of design of reinforced concrete omitting 'm' the modular ratio. The latest method of design developed by Prof. Saliger of Vienna is described. The correctness of the method has been checked by tests in England and America. The results obtained from the tests are shown to compare favourably with those obtained by Dr. Saliger's method.

THE IMPACT TEST FOR PILES. Pimm.

The impact test for piles as usually defined and applied possesses some very grave defects. These are discussed and a more scientific form of the test is suggested.

No. 4—April 1937.

EXPERIMENTS ON THE VIBRATION OF CONCRETE.

Review of the interim report issued by the Joint Committee of the Institutions of Civil and Structural Engineers on the vibration of concrete. The report deals with results of tests made on an experimental vibrating table which allows a vibration frequency of between 500 and 8,000 vibrations per minute. Conclusions arrived at on the basis of the tests are given. (See Bulletin No. 6.)

THE CONSTRUCTION OF LARGE DAMS AND PIPES.

Abstract from a lecture delivered by M. A. Coyne, the well known French engineer at a joint meeting of the *Societe Ingenieurs Civils de France* and the Institution of Civil Engineers. The lecture dealt with the design and construction of dams and pressure pipes, and strengthening of existing dams. The Mareges dam construction and the strengthening of the Grands Cheurfas dam in Algeria are described in detail. (See pages 46 and 47 of Bulletin No. 5.)

UNIFORM FLOW IN PIPES. Hogan.
Gibbs.

Continued from previous issue. In this article the resistance to flow developed by bends, elbows and tees in pipes is dealt with.

EXPERIMENTAL WORK ON ROADS.

Notes from the Report of experimental work on Highways Committee for 1935-36, are presented in this article. The experimental work covered a wide field and included tests on various types of transverse joints, shrinkage tests, concrete proportions, movement of road slabs jointless construction of concrete slabs and tests of various types of surface treatment. The results of the tests are discussed in brief.

REDISTRIBUTION OF MOMENTS IN CONTINUOUS BEAMS.

Results of tests undertaken to investigate the redistribution of moments incontinuous beams are published in the Report of the Building Research Board for 1935. The results are discussed in this article.

No. 5—May 1937.

IMPROVEMENT OF THE RIVER NENE.

A comprehensive scheme of river improvement is in progress under the Nene Catchment Board. The object of the scheme is to improve the drainage of the whole area and also to provide improved facilities for navigation. The scheme includes dredging of several reaches of the river Nene, and reconstruction of locks, weirs, etc. Details of some of the works are given, with illustrations.

THE MODULAR RATIO : A NEW METHOD OF DESIGN OMITTING *m*.

Discussions on the above paper by Mr. Manning, Mr. Mason and Mr. Adler are given. Dr. Saliger who is the originator of the new method of design further elaborates his principles and has shown with the aid of typical examples that the new method is simpler than the standard method. Mr. Manning criticizes the new method and sees no cogent reason for adopting it. Mr. Mason discusses the limitations of the new method and its advantages.

TESTING MATERIALS.

Synopses of the following papers presented at the International Association for Testing Materials held in London in April 1937, are given.

1. Relation between the tensile and compressive strengths of mortars and concrete, by R. Feret.
2. Porosity and permeability of concrete, by R. Feret.
3. Durability of aggregates, by A. T. Goldbeck.
4. Materials for the thermal insulation of buildings, by E. Griffiths.

THE SOIL-LINE METHOD OF RAFT DESIGN.—VII. **Baker.**

Continued from previous issue. Examples of calculations for a typical slab and beam raft are given.

THE ENGINEER.

VOL. CLXIII.

No. 4236—March 19, 1937.

MISCELLANEA.

PROTECTION OF METALS.

In the course of a paper on "Metallic Corrosion" read before the Midland Metallurgical Societies, Dr. Evans described the difference in the protective effect of red lead and iron oxide paints. As a result of a large number of experiments with sheets of steel covered with a coat of linseed oil and the two pigments, it was concluded that red lead was more effective in preventing attack of steel by corrosive agents.

WELD BRITTLENESS AT LOW TEMPERATURES.

A series of tests to ascertain if welds in steel have a tendency to brittleness at low temperatures has been carried out by Prof. Henry. The conclusion drawn was that welds in mild steel are in no sense brittle and are but slightly inferior to mild steel at both normal and low temperatures.

No. 4237—March 26, 1937.

NEW WATER SCHEME FOR DURBAN.

A new bill for this scheme is under consideration before the Parliament of the Union of South Africa. It is proposed to dam the Umgeni river at a point 30 miles from Durban in what is known as "the valley of a thousand hills". The reservoir will impound 5,000 million gallons. There will be a diversion weir at the head of the reservoir. The aqueduct will be 31·06 miles long comprising a pipe line and four tunnels. The water supply will be gravitational throughout.

MISCELLANEA.

GREATER VOLGA SCHEME.

This is a new scheme which has recently been taken up in the U. S. S. R. It includes large hydroelectric power stations on the Volga and the Kama rivers and the deepening of these rivers for the purpose of linking up the southern and northern seas and irrigating the dry steppes of the Volga. The hydro-electric power stations will have an aggregate capacity of 10,000,000 kilowatts.

CANADIAN ENGINEERING NEWS.

VANCOUVER BRIDGE.

Contract for building the bridge over the Vancouver harbour has been awarded. The structure will be the largest suspension bridge in the British Empire and will be 209 ft. above high-water. The cost of the bridge is estimated at 6,000,000 dollars.

No. 4238—April 2, 1937.

NEW TATA IRON AND STEEL PLANT.

The Tata Iron and Steel Company of India has announced an important programme of extensions to its plant at Jamshedpur. With these extensions the Tata Company and its associated concerns will be able to supply four-fifths of the aggregate Indian demands for rails, sleepers, sections, plates, sheets, tubes, wire rods, and wire.

ARCH DEFLECTIONS AND TEMPERATURE STRESSES IN CURVED DAMS.

Houk.

Temperature stresses in horizontal elements of arch dams must be computed in working out adequate designs. This article presents a method of computing the temperature stresses. Equations have been developed by the usual methods of arch analysis for arch movements at the crown due to thrust, shear, bending moment and temperatures. By manipulating these equations an expression has been obtained which shows that for given values of mudulus of elasticity, co-efficient of thermal expansion of concrete, and temperature change, the temperature stresses are proportional to the ratio of the radius to the thickness of the arch and the angle from the crown to the abutment.

MISCELLANEA.

RUST-PROOF PAINT.

A new product for protecting metal known as "Rust-eeter" has been marketed. It is applied direct to the rusted surface and reacts with the rust in such a way as to transform it into an essential part of the protective coating. It is a form of paint with a basis of chlorinated rubber. It is suitable for exposure to corrosive vapours, rain, salt water, and other climatic conditions. It can be sprayed as well as applied with a brush. It sets to the touch in 20 minutes.

WOOD PRESERVATION.

A new method of wood preservation has been patented in Germany. The material used is a silicic acid ester of phenols. It reacts on the moisture contained in the wood and produces silicic acid hydrates and free phenols. The toxic action of phenol renders the wood immune against decay, and fungi.

AIR AND WATER.

AERIAL PHOTOGRAPHY IN CANADA.

Aerial photography was introduced in Canada in 1922 and since then by this means 4,81,000 sq. miles of country have been mapped in difficult and unsettled regions.

PROTECTION OF TIMBER PILES IN SEA WATER.

At the Permanent International Association of Navigation Congresses an interesting method of protecting timber piling in sea water was described. In this method coatings of portland cement mixed with arsenious oxide, sand, and water are applied to the timber. A special form of cement gun was devised to apply the mixture. Driving of the piles caused no deterioration of the coating. The coating is applied over wire mesh reinforcement nailed onto the pile. The method can also be employed for the protection of concrete structures against the corrosive action of sea water.

ENGINEERING NOTES FROM CHINA.

The Jubilee Dam at Shing Mun was declared finished by the Governor of the Colony at the end of January. It is the highest dam in the British Empire and incorporates 2,000,000 tons of rock, sand and cement. It took five years to complete. A large labour force of 2,500 was employed and housed at the site. (See pages 25 and 28 of Bulletin Nos. 4 and 5 respectively.).

No. 4239—April 9, 1937.

VAAL RIVER DEVELOPMENT SCHEME.

Describes a scheme under construction in South Africa, for the irrigation of the Hartz River Valley. The scheme, which was briefly outlined in the Engineer December 11, 1936 (See pages 22-23 of Bulletin No. 5) is here described in detail. The works consist of a concrete gravity dam across the river Vaal with an earthen embankment on one flank The principal dimensions of the dam are :

Length along crest	1,700 ft.
Height above river bed	135 ft.
Upstream face	Vertical.
Downstream face	Batter 0·7 to 1
Quantity of concrete in the dam	220,000 cu. yds

The earthen embankment is 4,500 ft. long, with an upstream slope of 3 to 1 and downstream slope 2½ to 1. The dam will impound 800,000 acre ft. but with relatively minor additions to the crest provision has been made for a future impounding capacity of 1,800,000 acre ft. One main feature of the construction works was the dewatering of the river section and foundation excavations. These operations are described in detail. Concrete is placed by means of cable ways and dump buckets. In the construction of the earthen embankment, power shovels will load materials from the borrow pits to tip wagons, trains of which will be taken to the bank, drawn by light locomotives. The material will be rolled by rollers drawn by tractors.

The diversion weir which is about 350 miles downstream will divert the water to the head of a canal designed to carry 1,000 cusecs. The main canals consist of 100 miles of concrete lined waterways. The weir is 2,380 ft. long and 37 ft. high above the river bed. Several photographs showing the various stages of construction are included.

ARCH DEFLECTIONS AND TEMPERATURE STRESSES IN CURVED DAMS.

Houk.

Continued from previous issue. This article indicates a method of computing arch deflexions at crown cantilevers of curved concrete dams due to water load and temperature effects. The deflexions are given by two formulae due to Professor Cain. The author however suggests that for important dams over 100 ft. high designs developed on the basis of deflection adjustment at crown section should be checked by a detailed trial load adjustment at several additional cantilever sections before starting construction.

MISCELLANEA.

Water Power Resources of Canada. The annual review of the water power resources of Canada has been issued recently. The available water power is 20,347,400 H.P. under conditions of ordinary flow.

Anodising Aluminium Alloys. A note in *Iron Age* gives particulars of a process whereby aluminium alloys can be protected against corrosive attack in the salty air of sea coast locations. The alloy is used as an anode in an electrolytic bath consisting of a solution of chromic acid. An oxide coating is formed on the anode which effectively resists corrosive action.

No. 4240—April 16, 1937.

FORT PECK DAM.

This is a large earthen dam now under construction across the river Missouri in the north-east of Montana State in the U. S. A. The dam is designed to store the flood season run-off which will be utilized to maintain a depth of 8 ft. to 9 ft. in the lower reaches of the river for navigation all the year round. The dam is 1,875 miles upstream from the mouth of the river and is so located that the river water impounded at the dam has very little silt in suspension. The river below the dam site is a typical alluvial stream with an unstable channel and carries a heavy silt load. The dam will create a reservoir about 185 miles long with a maximum width of 17 miles and will impound 19,500,000 acre ft. of water. The maximum height will be 287 ft. America is famous for its monumental concrete dams and it may be asked why such a gigantic dam is being constructed of earth. The answer lies in the geological conditions of the site. The geological section consists of a 1,000 ft. thick stratum of shale underlying 150 ft. depth of alluvium. The character and thickness of this overburden rendered it impracticable to excavate down to the shale and construct a concrete dam from that depth. It was therefore decided to build an earthen dam and to tie it to the basic shale by means of a cut off wall of inter-locking sheet piles driven a little way through the sale. A number of photographs illustrating the construction are included. (See also pages 52, 54 and 55 of Quarterly Bulletin No. 3.).

WIDENING OF RICHMOND BRIDGE.

Richmond Bridge across the Thames near London is to be widened to suit modern traffic conditions. The piers will be enlarged by enclosing them with a line of sheet steel piling and concreting the foundations in this enclosed area. The extensions of the arches will be built of Portland stone faced with the original masonry. The stone arches of the old bridge are believed to be of insufficient strength to stand up to the modern loading requirements. It has been found however that if the loads are distributed instead of concentrated, they would be able to withstand stresses with a margin of safety. In order to ensure a distribution of the load, an ingenious plan will be adopted. The bearing surface over the crown of the arch will be a heavily reinforced concrete raft, supported upon a thick sheet of cork to distribute the load over the arch below. Each raft will be some 40 ft. long and will be constructed in two parts with an articulated division along the centre line of the bridge.

No. 4241—April 23, 1937.

FORT PECK DAM NO. II.

Describes construction operations, and works. The dam is being built in two sections as the tunnels or the diversion of the river are not yet ready and the river has an unobstructed flow at the centre of the dam site. Four dredgers are employed in forming the embankment which is being built up of the dredged material. Four diversion tunnels will divert the river water. The tunnels will be concrete lined and 24 ft. 8 in. in diameter. The combined capacity of the four tunnels will be 84,000 second feet. The spillway taps the prospective basin at a point 3½ miles eastward of the dam where nature has facilitated the creation of an outlet by providing a narrow dry valley. The final outlet of the spillway will be a channel reaching the river at a point 8 miles downstream of the dam. The spillway will have 16 stoney gates, each 40 ft. long by 25 ft. high. For a distance of a mile downstream from the spillway, the spillway channel will be lined with concrete on the floor and the side slopes. The piers and abutments of the spillway structure will rest on a solid slab of concrete 80 ft. wide and 12½ ft. thick. The slab is supported by 520 concrete cylinders 5 ft. to 6 ft. in diameter rising from shafts sunk 35 ft. to 40 ft. in the shale stratum.

MODERN HYDRAULIC TURBINES. Watson.

Describes the essential features of some typical modern turbines. Spiral cased turbines with vertical and horizontal shafts, and pelton wheels with horizontal and vertical shafts are described with illustrations. The 17,000 H.P. Pelton machine installed at Shanan, Punjab, India, the 15,000 H.P. sets of Pelton wheels of the Indian Tata power Company, and the Francis turbines of the Sivasamudram scheme in Mysore are described. Factors affecting the choice of different types of machine are discussed.

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

The International Congress of the International Association for testing materials was held in London in April 1937. The papers received number 250, of which the following three papers are reprinted.

1. The Phenomenon of Creep Recovery.
2. The Mechanism of the Creep of metals.
3. Effect of temperature on the properties of steels.

No. 4242—April 30, 1937.

MODERN HYDRAULIC TURBINES. Watson.

Continued from previous issue. Describes the Francis turbine and its development. Formerly, Francis turbines were used for medium heads below 500 ft. and Pelton wheels were used for higher heads. In recent years, the Francis turbine has gradually cut into the field of Pelton wheels for higher heads. Several improvements to the Francis turbine were effected with the increasing use of this type. Some modern installations are described including those at Niagara, and the Boulder Dam. The respective advantages of the vertical and horizontal shaft machines are discussed.

MISCELLANEA.

CORROSION RESISTANCE OF METALS.

Various methods of surface treatment of steel to increase corrosion resistance were recently discussed in a paper. Application of surface washes of phosphoric acid in alcohol solution to de-scaled surfaces is economically possible now as a result of researches.

THE COST OF COMPRESSING AIR.

In the course of a recent paper Major David has given a table showing the costs of compressing air by electric and steam driven compressors

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

A few of the papers presented at the Congress of the International Association for testing materials recently held in London are given. The following papers are included :—

1. Corrosion as influenced by increased temperature.
2. Deformation and fracture of metals as revealed by X-rays.

No. 4243—May 7, 1937.

THE VOLGA CANAL.

The Moscow Volga canal has been completed, and the capital has now been linked up with the Baltic Sea, the White Sea, and the Caspian Sea. The Moscow Volga canal is 80 miles long and transverses seven large lakes. The largest of the lakes has an area of 123 sq. miles. The canal has eleven lacks, twelve large dams and eight hydro-electric stations.

MODERN HYDRAULIC TURBINES.

Continued from previous issue. Turbines for low falls are dealt with in this article. Propeller type turbines are the most suitable for low falls. This may be of the fixed or adjustable blade type. The Kaplan turbine is described in detail, and some important turbine installations are described with illustrations.

AIR CONDITIONING AT THE NEW ALHAMBRA THEATRE.

The new Alhambra theatre being constructed in London will be equipped with air conditioning plant. The plant is designed to give a constant dry bulb temperature inside the building of 68°F when the outside shade temperature varies between 80°F and 30°F. The theatre will accommodate 2,300 persons. Each occupant will be supplied with 1,200 c. ft. of fresh air per hour. The rotary water vapour refrigerating plant is illustrated and described. The complete plant will deliver 1¼ tons per minute of correctly conditioned air to the theatre.

PRESENT TENDENCIES IN WATER TURBINE MACHINERY.

Fulton.

This article presents a discussion on the present day trends in the design of Francis turbines and Pelton water wheels.

No. 4244—May 14, 1937.

SINKING DEEP CAISSONS BY THE SAND-ISLAND METHOD.

This is a recently developed method of sinking caissons that has been used with success for the deep water piers of the New Orleans Bridge across the Mississippi river near Crescent City, U. S. A. The method consists of enclosing the area where the caisson is to be sunk by a steel sheel cofferdam and filling the enclosure with sand to an elevation above high water. A sand island is thus formed on which the cutting edge of the caisson is set precisely. The sand island is of a larger diameter than the diameter of the caisson. The caisson is sunk through the sand into the bed of the river. Some of the advantages claimed for the method are that the sand island being carried up to an elevation above high water level, flood waters cannot interfere with the work; the caisson walls can be built of reinforced concrete throughout, unweakened by the timber used in the conventional caisson; the concrete in the caisson walls is placed dry and in a place which is easily accessible. Some details of this method as used in the New Orleans bridge are given in this article.

MODERN HYDRAULIC TURBINES. Watson.

Continued from previous issue. Some types of thrust bearings are described in this article.

PRESENT TENDENCIES IN WATER TURBINE MACHINERY.

Fulton.

Continued from previous issue. - Describes a number of new improvements in the component parts being tried on modern Francis turbines and Pelton wheels.

SOUTH AFRICAN ENGINEERING NOTES.
VAAL-HARTZ IRRIGATION SCHEME.

The scheme has been half completed, and the major difficulties tackled and overcome. The distribution weir is 360 miles downstream of the main dam known as Vaal bank dam. (See page 22 of Bulletin No. 5.) This weir is a hollow wall of cement concrete 25 ft. high across the river. Solid rock had to be excavated to a depth of 25 to 32 ft. to carry the water from the Vaal river valley to the Hartz river valley. The length of this rock cutting is 4 miles.

No. 4245—May 21, 1937.

Not yet received.

No. 4246—May 28 1937.

THE WORLD POWER CONFERENCE TRANS-CONTINENTAL TOUR, No. I.

Describes the tour arranged in connexion with the World Power Conference in September 1936. One of the works visited which is described in this article is the Grand Coulee Dam. This dam is still under construction and will be 4,300 ft. long, 550 ft. high, 500 ft. thick at the base and 30 ft. thick at the top. It will be of concrete and of the straight gravity type. It will create an artificial lake 385 ft. deep at the dam extending 151 miles with an average width of ·8 mile.

No. 4247—June 4, 1937.

THE WORLD POWER CONFERENCE TRANS-CONTINENTAL TOUR, No. II.

Continued from previous issue. In this article are described the Skagit River Power Development scheme, and the Bonneville Dam Project. The former includes the Diablo Dam completed in 1930. It is a concrete dam of the arched gravity type 1,180 ft. long, 389 ft. high, and 146 ft. thick at the base. The reservoir provides 90,000 acre ft. of storage. The powerhouse is equipped with two 95,000 H. P.

The Bonneville Dam is of concrete gravity section with reinforce-ed concrete piers which will support eighteen vertical lift gates. The dam proper is 1,090 ft. long and 170 ft. high. and 200 ft. wide at the base. The dam is under construction.

No. 4248—June 11, 1937.

THE WORLD POWER CONFERENCE TRANS-CONTINENTAL TOUR, No. III.

Continued from previous issues. The Big Creek—San Joaquin Power Scheme is described. It supplies 532,172 H.P. The Shave Lake reservoir formed by building a concrete gravity dam 2,200 ft. long and 190 ft. high, acts as a water conservation and flood control reservoir. The Tennessee Valley Scheme is also described. A few of the dams included in the scheme, namely, the Wilson Dam, the Wheeler Dam and the Norris Dam are described. All these are concrete gravity dams.

ENGINEERING.

VOL. CXLIII.

No. 3723—May 21, 1937.

FLOOD CONTROL ON THE MIAMI RIVER OF OHIO Bennett.

The flood control works of the Miami River Valley of South Western Ohio were completed fifteen years ago. The works consist mainly of five large retarding reservoirs located at Key points along the valley. The river channel was also improved and flanked by levees through the nine cities along the river. The sole purpose of the works is for flood control and no permanent storage is permitted. The dams are earthen structures of the hydraulic fill type pierced by concrete conduit outlets whose action is automatic. The works have checked and controlled flood flow many times since their completion but the record floods of January 1937 gave them their maximum test. A hydrograph showing the uncontrolled and actual discharges obtained at Dayton shows the effectiveness of the retarding reservoir in controlling the floods of January 1937.

JOURNAL OF THE INSTITUTION OF CIVIL ENGINEERS.

No. 3—January 1936.

THE TREATMENT OF MUD-RUNS IN BOLIVIA. Morum.

A mud-run which may occur in any of the mountain ravines is composed of a flowing mass of detritus and water with the consistency of porridge. When the geological formation is comparatively new, the material forming the sides of the ravine slips down and is carried away by the torrential streams which occur during and after every rainfall. On the Bolivia Railway the mud-runs were a source of great trouble because they blocked up the openings provided for the flow of water and over-flowed the track. This paper · describes the methods adopted to control the mud-runs which include counter erosion cross walls across the valley and earthen dams. The principles of design of these works are set forth, and some actual works in existence are described.

FLOW BETWEEN PIERS : THE CASE OF SMALL LOSS OF HEAD.

Ionides.

A formula is given for determining the flow between piers. The formula contains a co-efficient which depends upon the ratio of the waterway between piers to the natural waterway in the channel and has been called the "obstruction ratio". In practical problems of design the formula may be used to determine width of waterway between piers. The conditions under which the formula may be applied are stated.

ENGINEERING RESEARCH.

The research recently carried out and in hand include investigations on :—

Reinforced concrete piles.

Temperature effects in concrete.

Workability and grading of aggregates.

Vibrations in buildings.

Deterioration of structures in sea water.

Foundations.

No. 7—June 1936.

CORROSION OF IRON AND STEEL.

Hadfield.
Main.

This paper describes some modern researches on corrosion of iron and steel including the work of the sea action committee of the Institution of Civil Engineers. The data obtained in the course of the research has been analysed statistically and results are discussed. Some practical exposure trials to examine the behaviour of various steels subjected to marine corrosion were also made. The results of these trials are discussed in detail.

THE RATIONAL DESINO OF STEEL BUILDING FRAMES.

Baker.

In 1929 the Department of Scientific and Industrial Research appointed a committee to investigate the question of revision of regulations governing the design of steel work for buildings in view of the improved quality of steel manufactured in recent years. The committee was in existence for six years and considered more than one hundred and fifty reports from investigators. The committee reviewed present methods and regulations for design of steel strutures including bridges, and investigated the application of modern theories to such design. The committee also made recommendations on the basis of their investigations on better and more efficient designs. The present paper gives an outline of the committee's work which will be of great value in following the full report of the committee. The experimental frame used in the investigations is described with some of the actual experiments conducted. Tests on existing buildings are also described, and results reviewed. The general behaviour of frames and stanchions, effect of floors, and behaviour of connections are discussed. The evolution of the new method of design is explained, and its application is shown by giving detailed calculations for a six storey building frame.

THE REDISTRIBUTION OF MOMENTS IN REINFORCED-CONCRETE BEAMS AND FRAMES. Glanville. Thomas.

This paper is in two parts. Part I describes tests carried out to determine the redistribution of moments that may occur in reinforced concrete beams, both at working loads and near failure, as a result of inelastic deformation of either the concrete or the steel. The term "redistribution of bending moments" is used to describe a departure from the distribution that would occur in a purely elastic frame work.

Part II describes investigations made with the object of examining the necessity for designing columns to resist bending as well as direct stress. Results of the investigations and tests are discussed at length and conclusions arrived at are stated.

ENGINEERING RESEARCH.

It has been decided to appoint a sub-committee of the Institution to investigate the problem of flow in open channels and pipes. The constitution of the Committee is given. A questionnaire is being circulated to various water authorities, seeking information on flow in pipes, etc.

The sub-committee on earth pressures has in hand the study of the shear strength of clay soils. A note summarizing the more recent work done is given. The note describes the method of measuring the shear resistance of clay soils under simple conditions of stress and with minimum restraint. This has been done with a torsional shear apparatus which is described. Compression tests were also made with a special apparatus. The results of the tests are discussed.

No. 1—November 1936.

ENGINEERS AND EMPIRE DEVELOPMENT :

PRESIDENTIAL ADDRESS OF SIR ALEXANDER GIBB.

He speaks of the contribution of the engineers towards the development of the Empire and to civilization. Some of the important works carried out by engineers on Canals, Roads, Bridges, Railways, Ships, Ports, Irrigation and water supply are mentioned.

THE RESTORATION OF THE BREACH IN THE RIGHT GUIDE BANK OF THE HARDINGE BRIDGE. Harvey.

The Hardinge Bridge over the Lower Ganges at Sara consists of 15 main spans of 350 ft. with 3 land spans of 75 ft. at each end. The piers are built on wells sunk 150 ft. below low water level. The steining of the wells consists of concrete blocks with a mass concrete core. The maximum discharge of the river on which the design of the waterway was based is 2,500,000 cusecs. The course of the river in this tract is unstable, and extensive training works were necessary to ensure its flowing through the bridge. The bridge was completed in 1915. In 1925 the river attacked the left bank near Sara and the action increased till 1931 when a portion of the revetment near Sara collapsed. The obstruction caused by the sunken work directed towards the right bank a strong current which threatened a serious embayment 2 miles above the bridge. The matter was referred to Messrs. Rendel, Palmer and Tritton, consulting engineers, and on their advice, the right guide bank was constructed in June 1933. In September 1933, a breach occurred in this guide bank due to abnormal rise of the river and the safety of the bridge was endangered. The services of Sir Robert Gales were requisitioned and he arrived in India in December 1933 and drew up a scheme of protection which was carried through before the next monsoon season. This paper gives a detailed description of the breach and the immediate steps taken to control the situation, discusses the causes of the breach and describes Sir Robert Gales' scheme of restoration. The actual construction of works comprising the scheme, the arrangements made in connexion with the construction operations and the experience gained in carrying out the works are described in detail. (See also page 120 of Bulletin No. 4.).

NEWRY SHIP-CANAL IMPROVEMENT SCHEME. Ferguson.

This paper describes the scheme of improvement of the Newry Ship-Canal which did not admit vessels large enough for the economical carriage of goods under modern conditions. The scheme comprised widening and deeping of the canal, bank protection works, new lock gates, and new wharf. The works are described in detail, and an analysis of costs is given at the end.

SIMPLE EXPERIMENTAL SOLUTIONS OF CERTAIN STRUCTURAL DESIGN PROBLEMS. Pippard. Sparkes.

A new method for determining experimentally the resultant reaction at different points in a loaded structure is described in this article. A model of the structure is cut out of sheet xylonite and is fastened down on a sheet of smooth paper in a manner appropriate to the support-conditions of the actual structures. The positions of a number of points on the model are marked on the paper and then a known displacement is given to the point at which the reaction is applied. The new positions of the original points are marked on the paper. The displacements of these points provide points for the influence line. The method is illustrated by working out a number of examples such as beams, segmental arches, spandrel braced arches, etc.

THE ACTIVE AND PASSIVE PRESSURES OF SEA-SAND BEHIND A VERTICAL WALL. Fordham.

This is an abstract from a paper describing experimental research carried out in order to find the actual distribution of pressure behind a vertical wall, and the general law of variation of pressure with depth of sand.

ENGINEERING RESEARCH.

REPORT OF THE FIRST INTERNATIONAL CONFERENCE ON SOIL MECHANICS AND FOUNDATION ENGINEERING. Cooling.

This is the report of the representative of the Building Research Station of England, who attended the conference held in June 1936. He gives his impressions of the conference and makes comments on each of the fifteen sections into which the Proceedings of the conference are divided. In a general review the author points out that the importance of soil studies has been recognized in nearly every country in the world, and more active co-operation is necessary between the practising engineer and soil worker.

Hydraulic research at the City and Guilds College include investigation of flow past roughened plates, and experiments with small models of spillway dams and weirs to determine causes of scour in the river bed below a dam. The resistance laws for flow in open channels have been studied by experiments with artificially roughened beds.

No. 2—December 1936.

No. 3—January 1937.

No. 4—February 1937.

These have been included in Quarterly Bulletin No. 5.

No. 5—March 1937.

THE SALONIKA PLAIN RECLAMATION-WORKS. Huntsman.

The Salonika Plain in Greece is a low-lying plain over 500 sq. miles in extent of comparatively recent formation and is composed of alluvium deposited by the rivers flowing through the plain. In 1925, the Hellenic Government entered into a contract with an American engineering company of New York whereby the company was entrusted with the execution of works of drainage, flood protection, regulation of rivers, improvement of communications and irrigation within the Salonika Plain. The object was to reclaim a large area of the plain and protect it from floods so that it could be utilized for cultivation. This paper deals with the design and construction of the whole of the project with the exception of the irrigation works. The works described include drainage channels river diversions, protective embankments, a circulatory canal to collect the discharge of the smaller streams and torrents river training works and a large number of bridges. Details of construction and organization, and results of the first year's operations are given.

THE LAKE COPAIS, BOROTA, GREECE: ITS DRAINAGE AND DEVELOPMENT. Dean.

The Copais plain in Greece is a natural basin about 130 sq. miles in area entirely surrounded by hills and mountains. This basin is 100 metres above sea level but there are no outlets for the water that flows into it and until recently it was largely a lake of varying depth. Various projects to drain the basin were formed, beginning in 1846, but none materialized until 1887 when a British company took over the unfinished project of a French company and completed it a few years ago. The drainage works comprising the project are described, and principle features of the design of the works are mentioned. The results and benefits accruing from the completion of the drainage works is reviewed.

FUNDAMENTAL RESEARCH ON THE APPLICATION OF VIBRATION TO THE PRE-CASTING OF CONCRETE. Stewart.

This paper presents results of experiments conducted by the author to determine the effect of vibration on concrete. The object was to try to establish a relationship between acceleration and density at a number of frequencies. The apparatus used is described, and other phenomena observed during the tests are discussed. The results of the experiments are presented graphically. The water content ratio and its bearing upon the strength of the finished product are discussed.

FLOOD-HYDROGRAPHS. Richards.

This paper is in two parts. The object of Part I of the paper is to put forward formulæ for the calculation of maximum intensity of flood and to arrive at curves indicating its rise and fall. The important factors affecting floods are given and the method of flood estimation put forward provides for all these factors. From the formulæ given, the flood hydrograph can be prepared. In conclusion, the author points out the limits of applicability of the formulæ and says that formulæ and recorded data are complementary in as much as the latter enable the values of co-efficients used in the formulæ to be determined while the formulæ can be used for catchments where sufficient data are not available.

Part II of the paper deals with the effect of a flood on a storage reservoir and describes a method whereby reservoir lag-effect and the maximum height to which the water level of the reservoir will rise with a given length of waste weir can be determined.

ENGINEERING RESEARCH.;

Interim report No. 1 of the sub-committee on vibrated concrete has been published The report describes the machine employed, the details of concrete mixture used and the tests carried out. Results of tests are discussed and conclusions drawn from the results are summarized.

RESEARCH WORK IN ENGINEERING AT VICTORIA UNIVERSITY, MANCHESTER, FEBRUARY, 1937.

Hydraulic research includes work in the development of the theory of dynamic similarity and investigations by models.

Investigations with models of the Severn Barrage and Severn Estuary have been completed, and a study is being made by means of a model of the effect of certain cut-offs in the river Mersey with a view to preventing floods.

No. 6.—April 1937.

KINCARDINE-ON-FORTH BRIDGE. Brown.

This paper describes the design and construction of the Kincardine-on-Forth Road Bridge which was completed in October, 1936. The bridge consists of—

(1) Three continuous spans of 62 ft. 6 inches.

(2) Fourteen steel spans of 100 ft.

(3) A centre swing span of steel of 364 ft.

(4) Nine reinforced concrete spans of 50 ft. with an arched underside.

(5) A piled reinforced concrete viaduct 265 ft. long.

The selection of site, setting out, details of piers and foundations, the swing and other spans, details of turning machinery of the swing span, and optrations during the construction are described.

THE NORTH BIHAR GROUP OF THE RIVERS AND WATERWAYS OF THE GANGETIC PLAIN BEFORE AND AFTER THE EARTHQUAKE OF THE 15TH JANUARY, 1934.

Abstract of a paper describing the characteristics of the rivers of North Bihar. The Gangetic plain in Bihar is being raised by detritus brought down by the rivers from the hills. The North Bihar rivers are discussed individually and certain conclusions arrived at which show that it would be best for the country to be evenly raised by the rivers running through one low place after another, the rivers being guided by digging channles rather than by building embankments.

ENGINEERING RESEARCH.

The Sixteenth Interim Report of the Committee of the Institution of Civil Engineers on Deterioration of Sea Structures has been published. A report is included on the deterioration fo reinforced concrete test pieces in sea water. The experiments indicate the need for adequate cover over the reinforcements. Results obtained with high aluminons cements are inconsistent and further work is being carried out thereon.

THE ROYAL ENGINEERS JOURNAL.

Vol. LI.

June 1937.

Floods in Fenland. Heath.

A large part of the Fen country is below sea level and the whole of it together with the Wash may be regarded as an arm of the North Sea which has been filled up with silt by the many rivers which enter it. The major portion of the present works to keep the sea out owe their inception to Francis, Earl of Bedford. In the spring of 1937, a large part of Fenland suffered from excessive floods and detachments of Royal Engineers were sent to the Fen area to help in fighting the floods. In this article a short description of the engineering works in the Fen area is given followed by a discussion of the causes contributing to the occurrence of the floods. The work done to control the floods and prevent further damage are then described.

The Seven-lens Aerial Camera. Thompson.

Describes the seven lens camera used in aerial photography and explains its functions.

WATER AND WATER ENGINEERING.

Vol. XXXIX.

No. 476.

Not yet received.

No. 477—April 1937.

The automatic flap weir at the Wunderklingen Pumping Station. Ringger.

Describes an arrangement of automatic flaps recently installed on the top of a weir to hold up water for the Wunderklingen pumping and electricity generating station. Eleven flaps have been installed. Each flap consists of a wooden plank bolted to an iron frame which is provided with journals turning in bearings at the lower end. The flap rests in a vertical position when water is held up. There are stops to prevent the flap from turning too far on the upstream side. The water pressure on the upstream face of the flap is balanced by a system of counterweights which exert a pull through wire ropes moving on pulleys at the lower end of the flap. The counterweights can be so adjusted that a rise in the level of the impounded water beyond a specified height would tend to raise the counterweights and turn the flap in the direction of the flow of water. When the river is in high flood, the flap rests in a horizontal position on the top of the weir. Details of the flap are described and illustrated by diagrams.

RECENT FLOODS IN U. S. A.

Review of an address before the Royal Meteorological Society on the recent American floods. The meteorological circumstances which caused the disastrous floods are discussed. Though the flood heights attained in 1937 were in excess of any previous floods, the damage to life was comparatively less due to accurate forecasts of times and heights of flood stages made by the U. S. Weather Bureau.

No. 478—May 1937.

EDITORIAL NOTES.

THE UTILISATION OF UNDERGROUND WATER RESOURCES.

In a paper recently read at the Junior Institute of Engineers it is stated that in a water well installation in the city of London for an office block, the capital cost of boring, pumping plan, etc. is repaid in about 4 years by the saving in water rates. In the case of a bore hole where no pumps are necessary, the well will pay for itself in six months. In an air attack, bore holes would be perfectly safe while present installations such as water tanks, pumping stations, etc., could be easily damaged. The life of a bore hole may be anything from 30 to 60 years. The possibilities of utilizing underground water should be explored.

WATER SUPPLY OF HONG KONG: THE SHIN MUN SCHEME. Smith.

Describes the construction of the Shing Mun Dam (see page 28 of Bulletin No. 5).

LETTER TO THE EDITOR.

TIDAL MODELS. Lacey.

An abstract of this letter has already appeared on page 158 of Bulletin No. 5.

No. 479—June 1937.

WATER LEVEL, FLOW GAUGING AND METEOROLOGICAL STATIONS: THEIR GRAPHICAL RECORDS, AS THE BASIS OF WATER SURVEY ON RIVER SYSTEMS. PART I.

McClean.

In this article is described the procedure of water survey of a river system with the object of obtaining complete information in regard to the water available in the system.

The general scheme of survey includes the establishment of permanent water level recorders on rivers at selected sites, the measurement of the flow, setting up and recording rain gauges where necessary, and compilation of records of water level, flow, rainfall, etc., in a form suitable for any analysis.

TESTING OF AGGREGATES FOR DURABILITY IN CONCRETE.

Goldbeck.

The most widely accepted, accelerated durability test is the sodium sulphate test. Aggregate samples are prepared by the use of designated sieves. The samples are then immersed in a saturated solution of sodium sulphate for 18 hours at 21 deg. cent., drying the sample to constant weight in an oven maintained at 105 deg. cent. to 110 deg. cent., cooling to room temperature and again immersing in the solution of sodium sulphate. Five cycles of this test are required for concrete aggregates. Finally the samples are washed free of sodium sulphate and dried. Each sample is then sieved through the same size sieve as was used in preparing the original sample. The quantity passing through the sieve is considered uncound.

There are many factors which interfere with obtaining consistent results in different laboratories. Recent investigators have made special recommendations for improving the test so as to obtain consistent results and some of these are mentioned. The test is not however considered sufficiently reliable for use in setting definite test limits in specifications and should be used only as danger signals.

LETTER TO THE EDITOR.

TIDAL MODELS.

Mr. J. Allen comments on Mr. Gerald Lacey's letter on the tidal model of the river Great Ouse and The Wash published in the May 1937 issue of the Journal. He compares the vertical exaggeration actually adopted with that required by Mr. Lacey's formula in the case of a number of models and has shown the wide difference between the two. With regard to Osborne Reynold's Mersey experiments the applicability of Mr. Lacey's formula to Reynold's models may be in the nature of a coincidence. He mentions the advantages of beginning with a vertical exaggeration on the large side in tidal model investigations which may be followed up by a further examination on a reduced vertical exaggeration model.

DEMAG NEWS.

VOL. XI, B.

No. 1—March 1937.

There is nothing of interest to irrigation engineers in this issue.

DIE BEAUTECHNIK.

(In German.)

VOL. 14.

No. 19—May 1, 1936.

APPLICATION OF ELECTRO-CHEMICAL METHOD FOR MAKING THE FOUNDATION OF PILES IMPERVIOUS.

This describes a laboratory experiment. "In driving piles the structure of clayey soils becomes strongly disturbed. Therefore the foundation piles have correspondingly lesser bearing capacity which depends on the friction between the surface of the piles and the disturbed soils. By the electro-chemical method of making soil impervious it is possible :—

1. to increase the friction between the pile and the clayey subsoil, and
2. to create a zone of imperviousness round the pile many times the diameter of the piles.

Thus will the bearing capacity of electrically made impervious piles be increased considerably. This capacity can be raised ten times or more, the longer the current flows and the higher its voltage".

(Translation of the article is also available.)

SCHWEIZERISCHE BAUZEITUNG.

(In German.)

VOL. 104.

No. 24—December 15, 1934.

There is nothing of interest to irrigation engineers in this issue.

VOL. 105.

No. 1—January 5, 1935.

A NEW ACCOUSTICAL METHOD OF MEASUREMENT FOR THE DETERMINATION OF PRESSURE· RELATIONSHIPS IN EARTHEN DAMS.

It is described in detail in "Wasserkraft und Wasserwirtschaft" No. 17 of 2nd September 1934. The apparatus is very simple and consists of a receiver and a measuring device, which is a steel chord under tension and serves as the sound producing element which can be attached to different points of the object under investigation. The sounds produced are compared with those of a standard chord and pressures can be determined. For the determination of pressure distribution on the foundations of structures, a measuring box is used which contains all the important parts of the apparatus.

(Translation of the article is also available.)

VIZUGYI KOZLEMENYEK.

(In Magyar but containing English summaries.)

VOL. XVIII.

No. 3—July-September 1936.

TYPES OF DAMS EMPLOYED IN THE CANALISATION OF THE MAINE AND NECKAR RIVERS.

Main types of dams and their features in the canalisation works of the Maine and Neckar rivers which are in progress are described in this article. Three types are dealt with, namely, the sluice gate type, the segmental type and the rolling type.

THE PNEUMATIC FOUNDATION.

This article describes the methods, the means, and the historical development of the pneumatic foundation, and conditions of working in such foundation. Some recent instances of the use of pneumatic foundation are cited.

REVUE GENERALE DE L'HYDRAULIQUE.

(In French.)

No. 13—January-February 1937.

A NEW EXPERIMENTAL CONTRIBUTION TO THE STUDY OF THE LAWS OF SIMILITUDE OF HYDRAULIC TURBO-MACHINES : RUNNING OF A HELICAL TURBINE UNDER A VARIABLE HEAD : INFLUENCES OF MECHANICAL LOSSES AND OF CAVITATION.

EVAPORATION AND THE DEFICIENCY OF FLOW IN THE REGION OF THE MEDITERRANEAN : SYSTEMATIC OBSERVATIONS OVER A LONG PERIOD OF THE EVAPORATIVE POWER OF A REGIN PROVIDING A CONTRIBUTION OF THE GREATEST INTEREST TO THE DEFICIENCY OF FLOW.

EXPERIMENTAL RESEARCH ON THE RATING OF CURRENT METERS IN STILL WATER. (Concluded from previous issues.)

This article gives the conclusions arrived at from the experiments.

THE QUESTION OF THE REJECTION OF AUTHORIZED PROJECT BEFORE JURISPRUDENCE. (Concluded from previous issues.)

This article deals with the legal rights of hydro-electric projects.

No. 14—March-April 1937.

A NEW EXPERIMENTAL CONTRIBUTION TO THE STUDY OF THE LAWS OF SIMILITUDE OF HYDRAULIC TURBO-MACHINES. (Concluded from Issue No. 13.)

Conclusions of the experiment are given in this article.

A CONTRIBUTION TO THE CALCULATION OF THE REINFORCEMENT OF JOINTS IN PIPES.

THE CATASTROPHIC FLOODS OF MARCH 1936 AND JANUARY-FEBRUARY 1937 IN THE UNITED STATES. **Parde.**

FAMOUS PRECURSORS IN HYDRAULIC : THE DIVERSE AND INGENIOUS MACHINES OF CAPTAIN AUGUSTIN RAMELLI.

THE AGRICULTURAL JOURNAL OF INDIA.

(Special Indian Science Congress Number, 1916.)

IMPORTANCE OF SOIL-AERATION IN FORESTRY. Hole.

This article deals with the damage that may be done to the seedlings of the Sal tree by insufficient soil-aeration when the physical condition of the soil is apparently suitable for growth.

THE IMPORTANCE OF SOIL VENTILATION ON THE ALLUVIUM. Howard.

A full supply of air in the soil is as important as a sufficiency of water. Some examples of the effect of improved soil ventilation on the growth of crops are quoted and discussed.

THE AQUATIC WEEDS OF THE GODAVARI AND PRAVARA CANALS OF THE BOMBAY PRESIDENCY.—A PROBLEM IN APPLIED ECOLOGY. Burns.

The author was called upon to examine and report on the weed growth in the Godavari and Pravara Canals. The result of his studies are presented in this paper. He classifies the weeds found, describes the growth of the most common weed, and discusses its ecology. The canals have been infected from the lake from which they draw their supplies. Reasons for the extraordinary prevalence of the weed in the lake are discussed. Variations of turbidity or velocity of water seem to have little effect on the weed. Prolonged closure of canals would kill the weeds but a closure which is sufficient to kill the exposed stems does not affect the underground roots which begin growing when water is again let into the canal. Methods for control should aim at prevention of fruit formation in the lake, repeated cutting or dredging by suitable apparatus in the canal, and uprooting the plants established.

THE CORRELATION OF RAINFALL AND THE SUCCEEDING CROPS WITH SPECIAL REFERENCE TO THE PUNJAB. **Jacob.**

The author has attempted to determine correlation of rainfall and areas sown, and of rainfall and outturn with a view to evolve a means of forecasting the amount of crop of any harvest. The correlations are based on the figures of the thirty years 1886—1915, and pertain to a tract in the Jullunder Tahsil of the Jullunder District in Punjab. A formula for prediction of the sown area of well irrigated wheat based on the correlations has been derived, as well as a formula giving the percentage of failure of crop.

AGRICULTURE AND LIVE-STOCK IN INDIA.

VOL. VII.

Part II—March 1937.

THE NEW SLOTTED POTTERY STRAINER.

Describes a new type of strainer for wells and tube wells. The strainer consists of cylindrical pipes of hard burned clay with vertical slots cut in the wall of the cylinder. The pipe elements are three inches in length, and two such elements built one above the other in a mild steel bar frame with aluminium end joints form a strainer unit. It is being sold to the well owners at Rs. 3-8-0 per foot.

Part III—May 1937.

FACTORY CANE-MOLASSES AS A CATTLE FEED. Labh Singh.
Gambhir Singh.

A suitable use for molasses which is a by-product of the sugar industry has engaged the attention of research workers for sometime past. This paper describes an experiment to determine the food value of factory cane molasses for bullocks, conducted at Lyallpur, Punjab. The results of the experiment are discussed and it is concluded that 2 lbs. of factory molasses could replace 2 lbs. of maize in a mixed ration for bullocks in the winter season.

NOTES.

BOARD OF AGRICULTURE AND ANIMAL HUSBANDRY. CROPS AND SOILS WING, 1937.

At the invitation of the Punjab Government, the second meeting of the Crops and Soils wing of the Board of Agriculture and Animal Husbandry will be held in Lahore from 6th to 11th December 1937. The next two days will be spent on a tour of inspection in Lyallpur.

GLEANINGS FROM HERE AND THERE.

(Issued by the Associated Cement Companies, Ltd., Bombay.)

No. 1.

No. 2.

In these issues there is nothing of interest to irrigation engineers.

THE INDIAN JOURNAL OF AGRICULTURAL SCIENCE.
VOL. VII.

Part I—February 1937.

STUDIES IN CROP ECOLOGY : THE COMPOSITION OF THE COTTON CROPS OF CENTRAL INDIA AND RAJPUTANA. Hutchinson. Ghose.

The Malvi cotton of Central India is believed to have deteriorated to a considerable extent in recent years. This paper reports the studies undertaken in an attempt to secure from the crop itself, satisfactory evidence concerning the alleged deterioration. The past history and the present status of the cotton crop in Central India has been investigated with a view to discover the causes and estimate the extent of deterioration. Information on Rajputana cotton crop has also been collected and is discussed. It is shown that the opinions of the local industry and the theories offered with regard to the deterioration are not supported by facts.

VARIATION IN THE CHARACTERS OF COTTON IN RELATION TO THE POSITION OF BOLLS ON THE PLANT. Sen. Mohd. Afzal.

This paper presents results of experiments conducted in an attempt to study the effect of position of bolls on the cotton plant on fibre length, fibre mass per unit length, and mean proportion of mature fibres. Study was also made of the extent to which the effect of climate supervened that of the position of bolls on the plant. Results are discussed and conclusions are summarized.

STUDIES IN THE WATER RELATIONS OF RICE: EFFECT OF WATERING ON THE RATE OF GROWTH AND YIELD OF FOUR VARIETIES OF RICE.

Sen.

Rice is a crop which is grown under very wet conditions. Experiments recently conducted show however that water requirements of this plant are similar to those of rye. The tradition therefore that very wet conditions are necessary for the growth of rice requires investigation. In Bengal and Assam rice is cultivated under a variety of conditions. Some fields are submerged under several feet of water during the growth of the plant, and others are on higher land and are irrigated by artificial means. In some parts of Bihar and Orissa, the practice is to drain the rice fields at certain stages of the crop, and to replace standing water by fresh water. All these facts point to the necessity of an investigation of the response of the plant to various water conditions. This paper presents the results of an experiment on the effects of watering on the rate of growth and yield per plant of four varieties of rice cultivated in Bengal.

HETEROSIS IN RICE.

Kadam.
Patil.
Patankar.

The luxuriant growth noticed in the first generation hybrids in most of the cereals and other crops is called "heterosis". This paper presents data on heterosis of the rice plant from crosses which were made for economic purposes.

INHERITANCE OF SHEATHED EAR IN RICE.

Sethi.
Sethi.
Mehta.

This paper deals with the inheritance of a peculiarity in rice consisting in the retention of the panicle within the leaf sheath. This peculiarity is noticed in one variety of rice grown in the United Provinces and this variety escapes the attack of the rice fly on account of this peculiarity. The inheritance of this protective natural device was studied and the results are presented in this paper.

Part II—April 1937.

STUDIES ON THE ROOT-ROT DISEASE OF COTTON IN THE PUNJAB.

Vasudeva.

This paper describes experiments with two organisms which are responsible for the root rot disease of cotton in the Punjab. Toxic effects of various chemical compounds on these organisms has been investigated in connection with the study of methods of control of the disease.

MOLASSES AS MANURE IN THE UNITED PROVINCES. Batham.
Sethi.
Nigam.

This paper describes the investigations carried out by the Agricultural Department of the United Provinces of the use of molasses as manure and summarizes experience in other countries. Conclusions arrived at from the results of the investigations are given. The more important amongst them are :—

1. The effect of molasses as manure is more appreciable on poor than on rich soils.
2. Molasses do not produce as high a yield of wheat as compost or cow dung but the increase of yield is appreciable in comparison to no manure.
3. Nitrogen fixation is enhanced in soils by the application of molasses.

CURRENT SCIENCE.

VOL. V.

No. 9—March 1937.

Nothing of interest to irrigation engineers in this issue.

No. 10—April 1937.

NEED FOR A SOIL SURVEY OF INDIA.

A discussion on the need of a soil survey of India was held during the Indian Science Congress week at Hyderabad in January 1937. The President in introducing the subject said that a soil survey could be carried out for one or more of many purposes. It could be carried out for settling new land, for ascertaining the physiscal and chemical characteristics of the soil with reference to manurial treatment, and for irrigation projects. There are about 150 million acres of cultivable waste land scattered all over India and it is necessary to ascertain the nature and the disposition of this waste land with a view to find out the most promising areas for reclamation. Survey for classificaion of soils is necessary for research and advisory work. He invited the speakers to suggest methods of survey that might be considered necessary on an All-India basis. Sir John Russell in the course of his address said that he attached great importance to a proper soil survey of any region where irrigation is to be introduced. Trouble from waterlogging is likely to follow irrigation unless the scheme has been planned as guided by a previous soil survey. Other problems of soil survey arise in connection with forestry. The proposal that Indian Soil workers should constitute a Committee to draw up an agreed basis for describing the soils and should indicate the methods of examination to be adopted was put forward by a speaker and Sir John Russell considered it a sound proposal.

A note prepared by Dr. R. McLagan Gorrie was read. The note stressed the importance of considering the protective and water storage aspects of natural plant cover before deforesting soils for agricultural purposes. Any form of soil survey should register the relative efficiency of the existing plant cover in maintaining the optimum soil profile and should indicate the trend of changes in the existing profile.

SCIENCE NOTES. Kamesam.

WOOD IS GOOD (Bulletins of the timber development section of the Forest Research Institute, Dehra Dun.)

Propaganda has been started by the Forest Research Institute with a view to advertise wood as a building material. In Europe and America, timber is looked upon as an important structural material while in India it is "nobody's child and has gone by default."

No. 11—May 1937.

RESEARCH ITEMS.

In *J. Res. National Bureau of Standards, 1936*, 16, a rapid method for the determination of silica in Portland cement has been described. The method consists in mixing the sample of cement with an equal quantity of ammonium chloride, digesting the mixture with hydrochloric acid for half an hour and filtering off the silica.

SCIENCE NOTES.

The Sugar Committee of the Imperial Council of Agricultural Research held a two day session on May 3rd and 4th, and discussed various problems connected with the Sugar Industry. The Committee considered the serious situation arising from the alarming expansion of the acreage under cane resulting in the production of cane far in excess of that for which there is demand. The Committee were of opinion that sugarcane cultivation should be spread over specially marked zones in the vicinity of particular factories. Proposals for carrying out a proper marketing survey of sugar were approved.

The Maynard Ganga Ram prize for 1935 was awarded to Mr. J. C. Luthra, Professor of Botany for his researches on the control of loose smut disease of wheat.

The award for 1932 has also been announced and goes to Mr. T. A. Miller Brownlie for his invention of a slip strainer suitable for augmentation of water supplies from bores sunk in open wells.

The silver jubilee session of Indian Science Congress will be held in Calcutta in January 1938. List of the various sections with names of Presidents is given.

No. 12—June 1937.

REVIEWS.

THE SPOTTED BOLLWORMS OF COTTON IN SOUTH GUJARAT, BOMBAY PRESIDENCY BY DESHPANDE AND NADKARNY.

The book deals with the results of investigations of the spotted bollworm carried out at Surat for 8 years from 1923 to 1931. The occurrence of bollworms in different parts of the world and in different places in India is discussed and the damage done to the cotton crop is described. Control methods tried by the authors are dealt with. The results of the investigations are useful not only to Gujarat but to different parts of India where cotton is grown.

SOME ASPECTS OF THE CHEMISTRY OF SWAMP SOIL. Subrahmanyan.

This article reviews certain chemical aspects of swamp soils having a bearing on the nutrition of the rice plant. In certain regions, specially river deltas, the yield of rice is maintained at a fairly high level without the application of manure. This high level of fertility is traceable to river silt. The bio-chemistry of river silt has not yet been adequately studied. The quantity of silt carried by different rivers, the amount deposited in different seasons, its distribution over the fields and its contribution to crop growth are problems awaiting solution. There is no doubt that some of the silts are rich and contain 3,000 parts per million of nitrogen. There is also evidence to show that river silt facilitates oxidation changes. In recent years evidence has been adduced to show that one of the causes of preservation of the fertility of swamp soils is the fixation of atmospheric nitrogen. The researches are worthy of extension. The influence of river silt on the nitrogen content of the soil is a subject which needs careful study. The writer then reviews some chemical changes which occur in swamp soils, and their bearing on the rice plant and indicates the problems which are worthy of further study. A striking feature about cultivation of rice is the enormous quantity of water required. The available evidence would suggest that swamp soils provide certain constituents which are not available in the dry soil, one of these being silicon. Probably there are many others which are necessary to the rice plant, and are released under swamp soil conditions. If the nature of these substances is determined it may be possible to provide them to the plant in dry soil conditions. A bibliography on the research work done on the subjects discussed is appended.

THE ENGINEER.

[A monthly official organ of the Mechanical Engineers' Association (India).]

VOL. XV.

No. 1—January-March 1937.

SOME NOTES ON TUBE-WELLS AND AIR-LIFT PUMPING. Vora.

This paper contains information collected from various sources on the hydro-electric and tube-well scheme in United Provinces, and details of tube well scheme for water supply of Cawnpore. Tube-well work in Baroda State is also briefly described. The drilling of wells and the equipment used are dealt with and the method of air lift pumping for raising water is discussed in detail Some types of deep well pumps such as reciprocating pumps, and centrifugal pumps are described.

THE INDIAN & EASTERN ENGINEER.

VOL. XXX.

No. 4—April 1937.

EDITORIAL NOTES.

FLOW OF WATER IN PIPES AND OPEN CHANNELS.

In a previous issue (See page 42, Bulletin No. 4) it was mentioned that a sub-committee of the Research Committee of the Institution of Civil Engineers has been appointed to investigate the problem of flow in pipes and open channels. An article by A. Auric in "*La Technique Moderne*" shows that experiments on this subject are also proceeding abroad. The author gives the working of a formula with explanation of terms for determining the product of surface slope by gravity, and suggests the advisability of the consideration of wind, surface, agitation, and atmospheric pressure. According to experiments there exists a veritable distinction between the laminar regimen and the turbulent regimen and it is necessary to adopt distinct formulae for each case.

MODERN ROAD CONSTRUCTION. Taylor.

Continuation of article in the previous issue (See page 57 of Bulletin No. 5). Describes surfacing with cement macadam, and resurfacing waterbound macadam roads with a 2-inch thick concrete slab. Drainage culverts of the box type, and other types are described.

THE STUDENTS CORNER. Antia.

The general conditions which should be incorporated in a contract document are given in this article.

No. 5—May 1937.

AN ELECTRIFIED CANE-SUGAR FACTORY. Godfrey.

Natal Estates, Ltd., own 30,000 acres of land of which 20,000 acres are under sugarcane cultivation. In the centre of this area is a sugar factory. Recently a comprehensive electrification scheme has been carried out in the sugar factory, details of which are presented in this article. A large power station with 3 turbo-alternators has been completed. The power will be utilized for driving the cane crushing and milling machinery, and for pumping water from the river Umgeni to a canal system for irrigation of the estates owned by the Company. The power house equipment, the milling plant equipment and the irrigation system are described.

METER FLUME DISCHARGE TABLES. Blench.

This article gives a new method of preparing discharge tables for simple flumes and multiple flumes with a common exit. The method is based on 'The principle of least squares'. At the outset a preliminary discussion of the flume formulae is given. The principle of least squares is then explained, and its application to the case of a simple flume is illustrated. Preparation of discharge table is explained, and the probable errors are discussed. In Part II of the article the method is extended to solve the problem of discharges through multiple flumes with a common exit. The article is accompanied by a number of tables illustrating the solution of actual examples.

THE STUDENTS' CORNER. Antia.

Some general conditions pertaining to contracts including those concerning payment, inadequacy of progress, stoppage of work, claims, and disputes, are dealt with in this article. Extracts from the general conditions of a particular contract are given at the end to illustrate some of the points dealt with.

No. 6—June 1937.

EDITORIAL.

WATER SUPPLY IN THE UNITED PROVINCES.

Review of the Ganges Valley State Tube Well Irrigation Scheme now under construction. The scheme provides for a net work of state tube wells at intervals of about 1½ miles.

Wells already sunk are of an average depth of 260 ft. yielding 33,000 gallons per hour. The cost of works for a complete tube well with electrical equipment is approximately Rs. 8,000.

VIBRATED CONCRETE.

Review of interim report No. 1 of the Joint Sub-Committee of the Institutions of Civil and Structural Engineers set up in 1935 to study the effects of vibration on concrete particularly in relation to the effects upon the setting and ultimate qualities of the concrete. The report contains details of all tests undertaken together with diagrams and tabular results. The conclusions arrived at in the report are set forth in this review.

LONG RANGE EXCAVATING.

Taylor.

Describes the general principles of the drag scraper, principal features of the equipment, and the use of the equipment in construction work such as building of levees, excavation of canals, deepening of rivers and in tunnel work.

THE BOULDER DAM.

Mr. Savage, Chief Designing Engineer, Bureau of Reclamation, U. S. A. was in England recently and delivered a lecture on the Boulder Dam before the Institution of Civil Engineers. The lecture was illustrated with films and lantern slides. The preparatory work included the building of a 33 miles long branch railroad, 32 miles of highway and a 200 ton cable way with a span of 1,256 ft. The construction facilities included 45 miles of standard gauge railroad complete with rolling stock, 20 miles of construction roads aggregate processing plant, cement blending plant, concrete mixing plant, and a 825 ton refrigeration plant for cooling mass concrete in the dam. The main features of the dam are described. The dam is a concrete arch gravity dam 726 ft. high, 45 ft. thick at top and 660 ft. thick at the base. Other structures such as spillways, intake towers, and power plant building are described briefly.

THE STUDENTS CORNER.

Antia.

Specifications for work describing the character and quality of materials to be used and methods to be employed in the execution of a work form part of a contract document. The points which should be borne in mind in drawing up specifications are described, and general specifications for some items of work are given.

INDIAN CONCRETE JOURNAL.

Vol. XI.

No. 4—April 1937.

Design of Reinforced Cement Concrete Beams. Desai. Sahani.

A method of designing R. C. beams is given in this article. The method is based on the use of a number of charts prepared by the author and lengthy and tedious computations are eliminated. The method of using the charts has been illustrated by a number of examples.

Proportioning Concrete Mixtures. Reynolds.

This is in continuation of the article in the previous issue. Two methods of proportioning are described: proportioning by trial, and proportioning by the "fineness modulus" method. When supplies are available it is sometimes convenient to use a mixed aggregate. The factors to be taken care of when using such a mixed aggregate are mentioned. In mass concrete work it is justifiable economy to build in 'plums' as the work proceeds. These plums can be blocks of stone or portland cement concrete not greater in size than can be handled by a man. Sharp cornered blocks should be avoided.

Cement for Subgrade Stabilisation.

'Stabilized soil cement' is the technical name of the newest type of road construction now under experiment in South Carolina. Fundamentally the process consists of mixing dry cement with the road soil that nature provided, pulverising it, moistening it, then packing it into a dense impervious mass, and finally rolling it to a smooth surface. An experimental project, consisting of 3·3 miles of a state highway treated in the manner described above has been completed recently. Details of construction procedure, equipment and working crew required, and other details are described in the article.

No. 5—May 1937.

News and Notes.

The Irrigation Department of Bengal decided to gunite the Anderson Weir. The work is now in progress.

The Increased Use of Vibrated Concrete.

The adoption of high frequency vibrators for placing concrete has been more rapid than the progress in acquiring basic information on such factors as frequency, amplitude, size and type of vibrator, period and method of application of vibration, etc. This article sets forth some recommendations with regard to the practice of vibration as applied to concrete.

STEEP CONCRETE FACE ON ROCKFILL DAM IN CHINA.

This article describes the Shing Mun dam in Hongkong. (See Bulletin No. 5, page 28).

PROPORTIONING CONCRETE MIXTURES. Reynolds.

Continued from previous issue. The method of measurement of materials in batch-boxes is described, and the manner of constructing batch-boxes is given.

No. 6—June 1937.

PRE-CAST UNITS TURNED OUT FROM MOULDS IMMEDIATELY AFTER CASTING.

M. Mopin a French Engineer has developed a new method of rapid production of precast concrete units. This is made possible by a system of vibration which with suitably graded aggregates gives to the concrete a gelatinous nature which allows it to be turned out of the mould immediately without damage. Recently a few housing schemes have been erected making use of pre-cast units on the Mopin system. This article describes some of the methods employed in the manufacture of pre-cast units. The descriptions are accompanied by numerous illustrations.

CONCRETE PAVEMENT IN SWAMPS.

Describes a type of road construction used in North Carolina for marshy soils. The least expensive type of construction in marshy soil has been found to be a reinforced concrete slab resting on piling.

REMOVING STAINS FROM CAST STONE AND CONCRETE. Baumgarten.

Recipes for cleaning cast stone and concrete which have proved successful are given in this article.

REINFORCED CONCRETE WELLS IN BARODA STATE. Ootia.

The geological formation of the upper strata in the Meshana District in Baroda is mainly of sand. In sinking masonry wells, a sandy current would often be encountered from one side or the other of the well. Sometimes the force of sand tends to blow up the masonry walls of the well. Reinforced concrete wells were therefore decided upon and this construction has proved successful. The method of sinking reinforced concrete wells is described and details of wells and well curbs are given.

PROPORTIONING CONCRETE MIXTURES. Reynolds.

Continued from previous issue. This article deals with reduction in bulk of concrete after mixing, and the method of determination of the proportions of mixed concrete.

INDIAN ENGINEERING.

VOL. C. I.

No. 4—April 1937.

NOTES AND COMMENTS.

The hydroelectric scheme now under construction in Fyzabad, U. P. is expected to be completed in August next and will irrigate 44,000 acres besides providing cheap power for the tube wells and cottage industries. Provision has been made in the scheme for future expansion on the lines of the Ganges canal grid system where within the last 5 years the total consumption has increased from 14,000 units to 2,500,000 units.

SIPHON SPILLWAY. Joshi.

Design for a High Masonry Dam.

This paper illustrates the principles of design of a siphon spillway for a masonry dam. This type of spillway is of recent development and possesses many advantages. There are no moving parts such as chains and gates. The siphon is automatic in starting and stopping, and acts with the full capacity immediately the priming level is reached. The procedure of design is illustrated by an actual example which is worked out fully.

SURVEY OF INDIA.

A review of the annual report of the Survey of India Department for the year 1936. Though the country is being mapped at the rate of 40,000 sq. miles a year, approximately 15 more years will elapse before a complete modern map of India is available. The early history of the Survey of India Department, and the progress and development of surveys are outlined in brief.

RAMPUR STATE TUBE-WELL SCHEME.

Abstract of a speech by Sir William Stampe, Chief Engineer, United Provinces on the occasion of the inauguration of the Rampur Tube-Well Scheme. A system of 34 tube-wells worked by electricity generated at Salawa power station on the Ganges Canal some 200 miles away is proposed, of which 10 tube-wells were opened, in the first instance. Sir William Stampe said that as a result of recent inquiries, the stability of the underground water-table can be relied upon. Cheap electric power is not only helpful in extending irrigation by pumping but enables the grower to process his grain. The material benefits derived such as reduction in cost of agriculture are mentioned. The development of social amenities round tube wells such as tanks for drinking water, masonry bathing pools, cattle tanks, and the radio, was suggested on the lines now being explored in the United Provinces.

No. 5—May 1937.

CO-ORDINATED RESEARCH.

In this article the editor puts forward a plea for the establishment of an all Empire organization for co-ordinating engineering research carried out all over the British Empire on the same lines as the Executive Council of the Imperial Agricultural Bureaux.

NOTES AND COMMENTS.

A preparation with the trade name "Inertol" which is a bituminous waterproofing compound for steel and concrete has recently been put on the market and is being extensively used, specially in corrugated iron roofing. It is manufactured in India.

A liquid waterproofing material for use in filling cracks on roofs, for joints in concrete and glass, and for construction of damp course is termed "synthaprufe". It is of the consistency of milk which sets in a short time.

HOME AND ABROAD.

The Menai Suspension Bridge built by Thomas Telford in 1826 is to be reconstructed at a cost of £228,000. The main features of the old bridge will be retained. There will be fewer chains and footpaths will be added on both sides.

DETERIORATION OF STRUCTURES IN SEA WATER.

Review of the sixteenth report of the special committee nominated by the Institution of Civil Engineers to investigate the deterioration of structures in sea water. It was found that treatment with creosote was the best remedy, but without the addition of any other chemical it was not so effective as a mixture of Creosote and D. M. With regard to metals it was found that only chromium and nickel steels are resistant to action to any extent. Galvanized steel plates show high resistance to corrosion. Experiments on concrete show that no one cement has marked superiority in withstanding sea action. Resistance increases with richness of mixture, and concrete of dry consistency is more resistant than that of normal constituency. Researches carried out by the Swedish Academy of Engineering science indicate that a mixture of 30 p. c. arsenious oxide and 70 per cent. of Portland cement after suitable heat treatment gives an increased resistance to the action of sea water.

SOME NOTES ON BRIDGE DESIGN. Pierson.

Brief notes of a general nature on girder design, and the pressure on the foundations of a bridge.

PRACTICAL TRIAL OF ROOFING SHEETS.

A paper was recently presented by Sir Robert Hadfield giving a brief account of a series of practical trials of roofing sheets of special steels being conducted at Sheffield. This abstract describes the trials briefly and sets forth the results observed so far. It was found that after 9 years exposure, painted sheets show no sign of failure. Amongst unpainted sheets, the copper steels are distinctly superior to ordinary steel. The zinc coating of sheets is worn off in about 5 years.

THE FRANKI PILING SYSTEM.

This system of piling has been introduced in India recently. It comprises the Franki concrete sheet pile and the Franki concrete bearing pile, both cast *in situ.* The procedure in both the cases is described in detail. A formula for determining the bearing power has been given.

NOVEL CONSTRUCTIONAL SYSTEM.

A new system of roofing called the "diagrid" system is described in this article. The design comprises essentially a diagonal system of beams or ribs which are arranged in two parallel sets equally spaced, intersecting each other at right angles, and rigidly connected at the intersection points. It can be carried out either in structural steel work or reinforced concrete. Bending moment is greatly reduced in this form of construction, and wide spans can be easily erected.

FOREST UTILISATION CONFERENCE.

The Inspector General of Forests, India, speaking at the Forest Utilization Conference held at Dehra Dun recently called attention to the value of timber in engineering construction. He mentioned the various activities of the Forest Research Institute in timber experiments and utilization of forest produce. Indian plywood has great possibilities. A certain type of timber has already secured a market in London. There is need for manufacturing companies to take up the manufacture of these lines in India. Work has been done at the Institute on wooden electric transmission poles, houses, bridges, etc. The questions of preservation of wood, and the seasoning of timber have been investigated. A preservative called "Ascu" has been developed which has given very satisfactory results.

No. 6—June 1937.

NOTES AND COMMENTS.

IRRIGATION RESEARCH

Comments on the new method of design of weirs on sandy beds recently evolved in the Punjab, as a result of researches by Rai Bahadur Khosla and Dr. McKenzie-Taylor.

HARDINGE BRIDGE.

Comments on the experiments at Khadakvasla with the models of the Ganges in connexion with the Hardinge Bridge at Sara.

HOME AND ABROAD.

NILE BARRAGE.

The new Mohamed Ali Barrage which is being built on the Nile north of Cairo will cost £2,250,000. 94 pairs of sluice gates and six power operated machines of special design to work the gates are to be built.

RIVER IMPROVEMENT WORKS : Lewis.

MODERN MECHANICAL EQUIPMENT.

Describes some types of machines used in the present day in river work, excavation, embankment building, and dredging. The machines described include dragline excavators of various types, bucket excavators, and dredgers.

LACEY'S FORMULAE—AN EXPLOSITION. Khushalam.

In this article an analysis is given, based on Lacey's formulae, with the object of finding the limits of discharge up to which determinate or real values for the dimensions of sections of channels could be obtained from Lacey's formulae. Both trapezoidal and elliptical sections are treated and it has been shown that for elliptical sections the limit for determinate dimensions of sections of channels works out to half of that obtained in the case of trapezoidal channels. The above finding is supported by actual conditions of large and small channels. In large channels only, the horizontal bed is perceived while all small channels assume an elliptical shape. From the equations derived by the author, he has prepared a table of minimum values of discharge for various side slopes and silt factors. He has also obtained by analysis equations for limiting values of velocities for trapezoidal and elliptical sections. From these equations it is seen that the limiting velocities are independent of the silt factor. In conclusion the author points out that the results he has obtained are purely from theoretical considerations and have not been verified in actual practice.

THE JAMES RIVER BRIDGE. Pierson.

A striking example of highway construction is a 16 mile Virginian road in America. The bridge over the James river on this road is the longest in the world being 5½ miles long. It has 447 short concrete spans each consisting of a concrete deck slab supported on steel I beam stringers resting on concrete piles. In addition to the short spans it has seventeen 90 ft. plate girder spans, eight 210 ft. through truss spans and a 300 ft. vertical lift truss span. Principal features of design and construction of the concrete deck and piles, the pier foundations, and the lift span are briefly outlined.

RESERVOIR SURVEYS. Fergusson.

A new method developed by the author of contour surveying for reservoir projects in which the field work is considerably less than in the case of the usual method has been described in this article. The method obviates the running of lines of levels across the valley at right angles to the line of traverse. The theodolite alone is used and horizontal and vertical angles to the various points are measured. From these angles the distances of the points and their heights above the point of observation can be worked out by simple formulae or from graphs prepared from the formulae.

JOURNAL OF THE ASSOCIATION OF ENGINEERS (CALCUTTA).

VOL XII.

No. 2—June 1936.

TUBE WELLS FOR WATER SUPPLY IRRIGATION. Ghosh.

Tube wells have evolved gradually from the ancient standard well during the last 60 or 70 years. To-day there are instances of 24 in. diameter tube-wells, 1,000 ft. deep from which water is pumped out at the rate of 100,000 gallons per hour. The underground water supply is replenished by rainfall, 80 p. c. of which goes to add to the underground reservoir. Geological features affecting underground supply are discussed. Some examples of artesian well water supplies in U. S. A., France, England, and Australia are quoted. The yield of a well depends on the velocity of the water passing through the sub-soil material without disturbing the finest sand. This velocity is called the critical velocity. In tube-wells this velocity is ½ in. per sec. The method of deciding a suitable spacing of tube wells in an area is described. Data of diameter, length of strainer, and discharge of some tube-wells in the Punjab are presented. A rough estimate for a water supply scheme to serve a town of 10,000 inhabitants has been given, and a scheme for irrigating an area of 1 sq. mile with costs has been worked out.

SCIENCE AND CULTURE.

Vol. II.

No. 9—March 1937.

Not yet received.

No. 10—April 1937.

NOTES AND NEWS.

IMPERIAL INSTITUTE OF SUGAR TECHNOLOGY.

The Imperial Institute of Sugar Technology at Cawnpore was declared open on March 11, 1937, by Sir Frank Noyce. The courses of study in the Institute are mentioned. A vast amount of research work will also be done at the Institute. The following researches are already in progress : treatment of factory effluents, cane drying, milling, methods of graining in pan boiling, and rapid and slow cooling in crystallizers. A scheme for investigating the possibilities of utilizing molasses for preparing cattle feed is also in hand.

NATIONAL ACADEMY OF SCIENCES, INDIA.

A monthly meeting of the Academy was held at Lucknow on 2nd March 1937. The undermentioned papers were read, amongst others.

1. Nitrogen fixation and azotobacter count on the application of carbohydrates and other energy materials to the soil, by Prof. N. R. Dhar and Seshacharyulu. In this paper, the effect of sunlight on nitrogen fixation and azotobacter count on the application of sugars to the soil has been studied. In all experiments there is greater nitrogen fixation in the presence of sunlight but less azotobacter count in sunlight.

2. **Changes in soil nitrogen after the addition of fresh cow dung to soil, by S. K. Mukerji. Fresh cow dung has been shown to fix atmospheric nitrogen in the presence of sunlight.**

No. 11—May 1937.

There is nothing of interest to irrigation engineers in this issue.

No. 12—June 1937.

LONG RANGE FORECASTING OF THE SOUTH-WEST MONSOON AND EVEREST EXPEDITIONS. Sen.

The prediction of the probable date of establishment and the prospects of the Monsoon about four months in advance is a scientific gamble when it is remembered that there are as yet no known rules for drawing up a long range forecast. The method of forecasting employed by the writer has achieved satisfactory results and is discussed in this article. The phenomena of the advance and retreat of the South-West Monsoon and the origin of the Monsoon are described in detail.

BREEDING FOR DISEASE RESISTANCE IN AGRICULTURAL PLANTS. Burns.

Some aspects of breeding new strains of plants with a view to disease resistance are discussed in this article. Some recent instances of work with new strains resistant to the wilt disease in cotton and linseed are given. Investigations are in progress on the rust resistance of wheat all over India.

HYDRO-ELECTRIC PRACTICE IN INDIA.

A book with the above title written by Prof. B. C. Chatterjee of the Benares Hindu University is reviewed in this article. The publication is in two volumes of about 600 pages each and costs Rs. 50. If the consumption of electricity *per capita* is taken as a measure of civilization and prosperity, the position of India may be gauged from the fact that while the consumption of power per head in the more advanced countries amounts to 2,000 units, in India it is 6 units. The sources of water power in India are in an undeveloped condition. The available water power amounts to 2 million kilowatts of which barely 3 per cent. has been developed. Vol. I deals with the general principles of hydro-electric development, *viz.*, feasibility of a scheme hydrology, elements of hydro-electric plant, power houses, turbines, regulating devices, etc. Vol. II deals with the descriptions of the various hydro-electric stations and sub-stations now operating in India.

NOTES AND NEWS.

INDIAN SCIENCE CONGRESS.

The Silver Jubilee Session of the Indian Science Congress will be held in Calcutta from January 3rd—9th, 1938. The various sections, with the names of the presidents are given.

THE MADRAS ENGINEERING COLLEGE MAGAZINE.

VOL. V.

No. 2—March 1937.

ATTRITION TESTS ON STONES USED AS ROAD METAL IN INDIA. Krishnan.

Attrition tests on road-making stones have been carried out in the engineering section of the Government Test House at Alipore, Calcutta, for the departments of Public Works of all the Provinces in India. The test is carried out by means of an apparatus called the Deval attrition testing machine. This article gives a description of the test as usually carried out and presents in tabular form results of tests on road building stones of the usual types met with in all Provinces. It is concluded that the best stones for road making purposes are the medium to fine grained compact basic rocks with more or less equiangular texture such as dolerite and basalt. Soft rocks like limestones, shales, and weaker types of sandstone are not suitable for any but light traffic.

DESIGN OF REINFORCED CONCRETE ARCH BRIDGES. Lakshmana Rao.

This article presents a procedure for designing reinforced concrete arches. The fundamental theory of the arch rib is discussed and the advantages of arches over straight beams are enumerated. The differences between a 3 hinged, 2 hinged, and hingeless arch are summarized. The hingeless arch is considered to be the best. Principles of design of a hingeless arch are then set forth. Three fundamental equations are derived based on the elastic theory. Other relationships are obtained from the three fundamental equations, and the arch can be designed with the help of these relationships.

THE MALAYAN AGRICULTURAL JOURNAL.

VOL. XXIV.

No. 9—September 1936.

AN ACCOUNT OF IRRIGATION AND DRAINAGE CONTROL ON AN AREA OF DWARF COCONUTS. **Wardlaw. Mason.**

An account is given of a method of irrigating coconut areas and controlling drainage in order to facilitate the free movement of subsoil water, one of the conditions favourable to the growth of coconuts. Two main channels, one irrigation and the other drainage, are cut along two longer sides of a rectangular block and also small alternating irrigation and drainage channels in the block of land itself. The level in the main drainage channel is kept below the irrigation channel. This difference in water levels causes a steady flow of soil water from the irrigation to the drainage canal through the alternating channels.

REVISTA DE LA SOCIEDAD CUBANA DE INGENIEROS.

(In Spanish).

VOL. XXIX.

No. 6—December 1936.

VOL. XXX.

No. 3—March 1937.

No. 4—April 1937.

No. 5—May 1937.

There is nothing of interest to irrigation engineers in these issues.

IRRIGACION EN MEXICO.

(Revista Mensual).

(In Spanish).

VOL. XIII.

Nos. 5 & 6—November & December 1936.

EXAMINATION AND INSTRUCTIONS FOR THE CONTROL OF SOIL AND ITS CONSOLIDATION FOR THE CONSTRUCTION OF EARTHEN DAMS. **Barona.**

A detailed article on the subject.

CHEMICAL ABSTRACTS (WASHINGTON, U. S. A.).

VOL. 30.

No. 11—June 10, 1936.

The Section dealing with Soils, Fertilizers and Agricultural Poisons mentions the following articles among others :—

1. A comparative study of the black earths of Australia, and the regur of India.
2. The infiltration and evaporation of water in the soil.
3. Soil Nitrogen.
4. Liming of soils.

The cement and other building materials Section mentions the following literature amongst others :—

1. Corrosion of cement.
2. Light-weight composition shingles.

ELECTRICAL NEWS AND ENGINEERING.

VOL. 45.

No. 21—November 1, 1936.

BOULDER DAM. ITS SALIENT FEATURES. Titus.

The principal features of the Boulder Dam Project are described, with special reference to the power developing part of the scheme. The Project provides for development of 1,800,000 H. P. in two power houses. The power generating units are described.

CURRENT FARM ECONOMICS (OKLAHOMA).

Series 49.

VOL. 10.

No. 1—February 1937.

Deals with prices of farm products and other aspects of economic problems in U. S. A., with particular reference to Oklahoma.

CIVIL ENGINEERING (NEW YORK).

VOL. 6.

No. 6—June 1936.

THE FUNCTION AND DESIGN OF CHECK DAMS. Baumann.

Soil erosion control is an essential element of flood control. Erosion precludes the growth of vegetation and results in increase of run-off and floods. The check dams system constitutes the first line of defence against erosion. They hold back the flow temporarily, causing the deposition of material carried by the water. The stream bed is thus raised and the side slopes are flattened. This causes a decrease in velocity and scouring action. Check dams provide no direct protection against major floods. Their effect is indirect in that they stabilize the soil and promote the growth of vegetation which reduces the run-off. Rules useful in the design of check dams based on twenty years' experience in the San Gabriel mountains and in the Alpo have been given. The writer considers that to build a check dam system absolutely immune to onslaughts from landslides, boulders and mud avalanches produced by cloudbursts is impossible. "Engineers may well remember what the French philosopher and mathematician, Pascal, said almost three hundred years ago. He said that two natural phenomena would never be quite understood by men—women and water."

SAFETY FACTORS IN HIGHWAY DESIGN. Rader.

Frequency of road accidents makes it imperative that in modern road design attention should be paid to provide every requirement for safe operation of high speed traffic. This article describes some of the features in design to ensure safety such as adequate width and number of traffic lanes, increased sight distances, reduction of curvature and grades, better designed railroad and highway crossings provision of footwalks, and use of intensive lighting.

CURRENT PERIODICAL LITERATURE.

DAMS.

Technique Moderne, April 1935.—Discussion of theory of weirs and low dams on permeable ground. Laws of movement of water through pervious formations. Review of model experiments.

VOL. 7.

No. 3—March 1937.

ACTIVITIES OF THE NATIONAL WATER RESOURCES COMMITTEE.

A symposium containing abstracts of articles presented at the annual meeting of the American Society of Civil Engineers on January 20, 1937. The following articles are included :—

1. RESUME OF THE DRAINAGE BASIN STUDY REPORT. Wolman.

This article reviews the report of the Water Resources Committee. The Committee was requested to determine the principal water problems in the various drainage areas of the country and to outline in broad terms a unified plan of water development and control designed to solve those problems. It was also requested to recommend specific projects as part of the unified plan. The Committee has released the drainage basin study report. The report defines the characteristics of a sound water policy, stresses the urgent need for developing basic hydrologic data now lacking, recommends quantitative studies of the effect of vegetable cover and soil erosion upon hydrologic phenomena and recommends investigations of coastal erosion phenomena and the effect of beach protection works. Regional power market surveys are also considered necessary for an orderly development of streams. The report includes more than 7,000 proposed projects.

2. THE NATIONAL DRAINAGE BASIN STUDY. Fowler.

This article describes the study in general and calls attention to the need for further investigation.

3. WATER PLAN FOR THE RED RIVER OF THE NORTH. Horner.

This article describes the formation of an interstate Committee on "Water plan for the Red River of the north" and the work carried out by the Committee The major problem of the area is the conservation of flood water and its release and transportation in stream beds, and a co-ordinated water plan was drawn up by the Committee based on this problem. The plan provides for construction of reservoirs, and improvement of stream channels.

4. THE RIO GRANDE JOINT INVESTIGATION. Barrows.

This article describes a joint investigation of the water resources of the Rio Grande Basin by an interstate Commission, and the National Resources Committee.

5. COLLECTING AND PUBLISHING HYDROLOGIC DATA. **Saville.**

This article is a review of the report of the special advisory committee on hydrologic data appointed by the Water Resources Committee. This special committee undertook to set forth standards for the collection and publication of hydrologic data. The recommendations made by the Committee are given.

SOME RECENT HIGHWAY DEVELOPMENTS.

This is a symposium on recent developments in the highway field consisting of abstracts of three papers delivered before the annual meeting of the American Society of Civil Engineers on January 21, 1937. The papers are :—

1. STATE-WIDE HIGH PLANNING SURVEYS. **Fairbank.**

Extensive planning surveys with Federal funds have been undertaken by forty States. The surveys include an inventory of road details and structures, study of traffic as to character and flow, weight and commodity surveys, financial compilations, and studies of road life.

2. HENRY HUDSON PARKWAY AND ITS TRAFFIC. **Downer.**

Describes an important road recently constructed.

3 RURAL ZONING AND HIGHWAY IMPROVEMENT. **Carmalt.**

This article discusses various ways of roadside improvement in rural areas.

A STEEL-PILE PIER IN TROPICAL OCEAN WATER.

Among the more important design features are the omission of underwater bracing, provision in the design for earthquake stresses, and the use of gunite concrete over the entire immersed lengths of piles before driving, to guard against damage by destructive marine growth.

REPORTS OF RESEARCH COMMITTEES.

This article discusses various ways of roadside improvement in 1934 and its principal activity is the general advancement of knowledge in the field of hydraulic research, with emphasis on open channel hydraulics and model tests. The investigations of the Committee include :—

1. Tests on full sized structures to verify results of previous hydraulic model tests. Facilities for comparing prototype behaviour with previous model performance are being installed in works under construction.
2. Investigation of problems on fundamental research. Five problems are being studied, which are : travelling waves on steep slopes ; curves in open channels ; phenomena in intersecting streams ; the conversion of kinetic to potential energy ; sedimentation at the confluence of rivers.

The committee is preparing an up-to-date manual of hydraulic laboratory practice to aid in securing greater uniformity in the method of approach to the solutions of practical problems by model studies.

The committee is co-operating in a project intended to secure English translations of important papers on hydraulics appearing in other languages. A set of letter symbols for use in hydraulic laboratories has been tentatively adopted by the Committee. (See page 76 of Quarterly Bulletin No. 5).

ENGINEERS' NOTEBOOK.

ELIMINATING TRIAL AND ERROR IN BACKWATER COMPUTATIONS. Irwin.

Describes a graphical method of computing backwater profiles based on Manning's formula. This method eliminates trial and error and is quick and accurate.

DISCHARGE AREA OF CIRCULAR GATES. Nelidov.

Gives a method of computing area of a circular gate at partial openings by a graphical method.

DESIGNING STABLE CHANNELS AND COMPUTING BED-LOAD MOVEMENT. Hedberg.

Since 1932 Prof. Meyer-Peter and his associates have been conducting studies of the movement of bed load materials in the University of Zurich, Switzerland. Two papers have been published giving a description of the experiments and proposals for the utility of their findings. The present article is a review of these papers. Prof. Meyer-Peter has formulated an equation connecting discharge per unit width, friction slope, diameter of bed load material, and quantity of transported material per unit width. The limitations to the uses of this equation are discussed. In a typical case where bed load movement does not take place, the Meyer-Peter equation used in conjunction with Manning's or Kutter's formula provides a complete solution for the design of a stable channel of any shape. This has been illustrated by working out an actual problem. In their second paper, Prof. Meyer-Peter and his associates explain the use of the equation for calculating bed loads in natural streams and for designing the regulation of such streams. The points that arise in practice in this use of the equation are discussed and the writer concludes by saying that although the theory is well substantiated in the laboratory there is an urgent need for verification from nature.

CURRENT PERIODICAL LITERATURE.

DAMS.

Concrete Arch Dam, Buchanan, Texas. *Compressed Air Magazine*, Nov. 1936. Plan and construction operations of L shaped multiple arch dam 11.200 ft. long on the Colorado river, consisting of 29 reinforced concrete arches of 70 ft. span and maximum height of 160 ft. are described.

Seepage and uplift under dams. *Military Engineer*, Septr. Oct. 1936. Describes determination of gradients beneath structure, method of obtaining flow and pressure lines, seepage through silt, sand and gravel, relation of gradient to foundation failure, and determination of uplift pressure.

FOUNDATIONS.

Underpinning and foundation work in loose and waterlogged ground by chemical consolidation, ground-water lowering and other means. *Structural Engineer*, June 1936. Describes British experience with Joosten chemical process of consolidation, and ground water lowering etc.

No. 4—April 1937.

PLANNED UTILIZATION OF WATER RESOURCES. Morgan.

Abstract from a paper read at the Third World Power Conference held in Washington in September 1936. Most of the earlier water control projects in the United States have aimed at control for particular usage. In recent years however, the aim has been to secure the greatest public benefits for all purposes. It has come to be recognized that the many uses of water are inter-related, and an adequate system of planned utilization of water resources is essential. The writer then proceeds to review the more or less spontaneous growth of water developments in the U. S. A. and the results achieved. The development of Mississippi river for navigation and flood control is discussed. Control of Missisippi has suffered from two types of extremist views. One of these is that levees are the only means of control, and the other view strongly supports reservoirs in the headwaters as the most effective means of control. The conflict in the two views has been a great handicap in the development of effective flood control. There are other instances where comprehensive planning has achieved very successful results such as the Miami Conservancy District.

Power and Irrigation development are essential elements of some of the new expensive projects. The irrigation project furnishes the basic market for power output and the revenue from power covers a large part of the irrigation cost. Domestic water supply from surface water is closely related with flood control, forest cover soil erosion and regulation of river flow. In previous years, development of power sites was considered a single purpose undertaking. With the rapid improvement of steam power development during the past decade, the economy and flexibility of steam power is a challenge to hydro-electric power. When sites are developed for a variety of purposes it might be possible to produce power at a cheaper cost.

Comprehensive legislation, both Federal and State is needed for the integrated development and utilization of water resources in U. S. A. The essentials of such legislation are discussed. The work of the Tennesse Valley Authority is then described as an example of planning for the unified control of a great river system. (See Quarterly Bulletin No. 3, page 90).

GEOPHYSICAL METHODS AND CONSTRUCTION WORK. Stipe.

The application of geophysical methods to civil engineering for determining the nature of underground formations is of recent origin. Some general methods employed are briefly described. In the magnetic method, modified compasses are used for measuring distortions in the earth's magnetic field caused by the varying magnetic permeabilities of the underlying rock formations. In the gravitational method, sensitive torsion balances are used to detect variation in gravitational pulls which result from differing densities of, the underlying rocks. In the Seismic method, the time required for vibrations set up by artificial means such as explosives at a known distance underground to travel to the earth's surface is an index of the nature and depth of the formations. The time taken varies with the elasticity of the formations through which the vibrations are transmitted. A seismograph is used to detect the vibrations reaching the surface. The electrical method has proved the most useful and dependable in civil engineering work. This method depends on the fact that the various materials of the earth's crust offer different degrees of resistance to the flow of an electric current. An electric current is passed through the ground, and the strength of the ground current is measured at various points. The power source and measuring circuits are connected to the ground by means of short metal plugs driven a few feet inside the earth.

A few actual cases where these methods were used and the results obtained are given. These include dam sites, harbour survey, determination of water bearing horizons, and in highway work.

MAP MAKERS AND MAP USERS. Bowie.

The author says that with the growing population of the United States, the increasing importance of the need for conservation of natural resources is apparent. Accurate maps are necessary for the surveys of these resources. A national mapping programme should be pushed forward. The author then proceeds to outline modern procedure in map making including aerial photography, and concludes with a description of the national control surveys and uses of control survey data.

THE MENAI SUSPENSION BRIDGE AND OTHER BRIDGES DESIGNED AND CONSTRUCTED BY THOMAS TELFORD. Baker. Amritage.

The Menai Bridge was completed by Telford in 1826 and was a unique piece of work. The suspension span is 580 ft. The towers are 153 ft. above high water level and the bridge has a clearance of 100 ft. above high water. The roadway is 28 ft. wide and the chain system consists of 4 groups of chains, each group consisting of 4 chains of wrought iron links 1 in. thick and 3¼ in. deep. The anchorages and their construction are described. A smaller bridge, also of the suspension type, built by Telford called the Conway Bridge is also described. Experiments carried out by Telford to determine the transverse load which could be suspended from a stretched wire are described. Telford was the first President of the Institution of Civil Engineers.

MOVEMENT OF BOULDER DAM DUE TO GROUTING. Simonds.

Boulder Dam consists of a large number of vertical columns separated by vertical joints which were subsequently grouted to combine the columns into a monolithic structure. In this article a description is given of how measurements were made of the block deflexions caused by grouting the vertical joints. Blocks of a dam are designed for stability under water pressure but they may not be stable under a high grout pressure in the contraction joints. The apparatus used in measuring the change in width of joints is described, A description of the cooling system consisting of pipes embedded in the body of the dam in order to dissipate the heat liberated by the setting concrete is also included.

ENGINEERS' NOTEBOOK.

ARTIFICIAL VIBRATION—A NEW METHOD OF DYNAMIC RESEARCH. Bernhard.

A new method of testing structures by inducing artificial vibration in them is described herein. It is claimed that the method is very useful in making studies of earthquake forces.

SOCIETY (AMERICAN SOCIETY OF CIVIL ENGINEERS) AFFAIRS.

COMMITTEE ON FLOOD CONTROL.

By authorization of the Board of Direction of the Society, a Committee on flood control has been appointed to make a general appraisal of flood control methods with particular reference to their physical and economic limitations.

CURRENT PERIODICAL LITERATURE

DAMS.

Western Construction News Vol. II, No. 9, Septr. 1936. Description of the repairing of Lake Pleasant multiple arch dam in Arizona which is 2,000 ft. long and 250 ft. high, by filling buttresses with concrete, adding heavily reinforced cross wall along upstream face of buttresses, and adding a series of horizontal floors at various elevations.

FOUNDATIONS.

Western Soc. of Engrs. J., Vol. 41, No. 4, Aug. 1936. Description of shoring and underpinning for foundation failures, and procedure for deep underground construction; also emergency shoring and building moving.

No. 5—May 1937.

THE FLOOD OF 1937 IN THE OHIO VALLEY. Horn.

The causes of the recent flood in the Ohio are discussed, and the 1937 flood is compared with previous floods on record. The 1937 flood is attributed to excessive rainfall in the Ohio valley, particularly in the lower reaches. Engineering operations during the flood consisted of safeguarding existing navigation works, collection of data as regards rainfall and flood heights reached, and the relief operations. These are briefly described. The author is of opinion that a flood greater than the 1937 flood can occur in the Ohio valley. In planning flood control measures, allowance should be made for a 'superflood' providing conditions more unfavourable than the 1937 flood which itself constituted a record.

A system of 88 reservoirs located on tributaries of the Ohio river has been recommended for flood control. The author believes that a reservoir system alone cannot be counted upon to give complete protection from major floods. The effect of the reservoirs decreases as the mouth of the main river is approached. A flood control scheme must be so designed as to be capable of development into a more elaborate system later on and should easily lend itself to operation under varying flood conditions.

GEOLOGY OF DAM SITES IN HARD ROCK. **Mead.**

Paper presented before the Second Congress on Large Dams at Washington in September 1936. In planning a dam, a knowledge of the geological features of the site is indispensable to the hydraulic engineer. Information on the geological nature of the foundations is obtained usually by core boring and core drilling, churn drilling, wash boring and geophysical prospecting. Physical properties of different types of rock such as igneous and metamorphic, sandstone, and limestone which are of importance to the engineer are discussed in relation to dam foundations.

PRINCIPLES OF SOIL STABILIZATION. Housel.

"Soil stabilization may be defined as any procees of treating a soil mixture to improve its ability to resist deformation under load and to ensure durability of the desirable state produced". The properties of soil mixtures which are important factors in soil stabilization are discussed. particularly as applied to sub-grades. The soil stabilization methods developed up to the present time are described. These are : mechanical compaction at optimum moisture content, proportioning of soil mixtures, and use of chemicals to supply cohesion to the granular mass of soil.

ECONOMIC JUSTIFICATION FOR FLOOD PROTECTION. White.

Methods for determining whether flood control works are justified on economic grounds are discussed in this article. Typical methods of calculating benefits and costs are given. Deficiencies in the present technique of estimating the economic justification of flood control projects are discussed.

ENGINEERS' NOTEBOOK.

DISCHARGE OVER A FREE FALL. Langbein.

The author reviews some of the more important formulæ in force for calculating discharge over a free fall. These formulæ are applicable under special conditions, such as parallel flow at critical depth in the approach channel. In actual practice, approach channels with steep gradients and velocities above the critical are frequently met with. The author suggests a more general approach in the solution of the problem, and has evolved a formula which is generally applicable under all conditions.

ADDITIONAL SOLUTION FOR BACKWATER FORMULA.

Mr. Goodwin presents an alternative graphical method of solution of Manning's backwater formula. (See issue of "Civil Engineering" dated March 1937 in this Bulletin).

Bridges : Piers, Foundations. *Bauingenieur* Oct. 2, 1936. Gives geological methods and tests for determining dependability of underlying strata and methods of improving them for ensuring adequate supports for caissons.

Dams : Concrete Arch dam in Algeria. *Technique Moderne* Jan. 1, 1937. Describes a reinforced concrete multiple arch dam 46 m high and 260 m long. Concrete mix, vibration of concrete, construction of cut-off, are also described.

EDISON ELECTRIC INSTITUTE BULLETIN.

VOL. V.

No. 1—January 1937.

THE PLACE OF THE ELECTRIC WATER SYSTEM IN A RURAL ELECTRIFICATION PROGRAM.

Rice.

The programme of rural electrification in America has progressed only so far as to pay for the bare cost of service only. The chief problem now is of increasing the use of the service so as to secure better revenue returns. This can be achieved by extending the use of the various equipment and appliances available to render the greatest service to customers. In this article the writer has analysed one such equipment namely the electric water system in rural areas in order to determine its revenue possibilities. He discusses the basic need for such equipment, the interest of the farmers in it and the immediate revenue possibilities to the power company. The potential revenue possibilities are considered and it is suggested that the desire to instal electric water system installations in rural areas should be created by a systematic advertisement campaign.

ENGINEERING NEWS-RECORD.

VOL 118.

No. 9—March 4, 1937.

WHY DESILTING WORKS FOR THE ALL-AMERICAN CANAL?

Vetter.

The All-American Canal takes off the Colorado river at a point 300 miles below Boulder Dam site. Special desilting works designed to remove 70,000 tons of silt per day have been built at the head of the All-American Canal. In view of the fact that the Boulder Dam will arrest all the silt coming down the river, the necessity of desilting works at the head of the All-American Canal has often been questioned. In this article the author explains the necessity of the desilting works. Observations of the retrogression of river bed below Boulder Dam are taken regularly and these observations show that the clear water discharged below Boulder Dam picks up material from the river and causes retrogression below the dam. Imperial Dam at the head of the All-American Canal and Parker Dam, midway between Boulder and Imperial Dam will reach completion at about the same time. The silt charge picked up by the river between Boulder and Parker Dams will be arrested at the reservoir formed by the Parker Dam. The clear water issuing below Parker Dam will pick up fresh material from the river bed till the stream becomes saturated with silt. This silt will first of all be deposited in the reservoir formed by the Imperial Dam, and within a relatively short period of time the accumulated silt may be expected to reach the sills of the headgates of the canal, after which it will enter the canal. To prevent this entry of silt into the canal, desilting works were necessary.

PILE PULLING AND RE-USE CUTS COFFERDAM COST.

This article describes the procedure of pulling out piles from one Cofferdam after work is finished and using them again in another. This procedure has been adopted with success at the Pickwick Landing Dam.

PROTECTING NORTH CAROLINA BEACHES AGAINST WIND AND WAVE EROSION.

Abstract of a paper presented before the American shore and beach preservation Association. To combat severe erosion on the windswept and treeless beaches of North Carolina, protective works are being carried out on 175 miles of the coast. The method of protection adopted is the creation of sand dunes which could be held in place by planting protective covering of grasses, and native trees. Brush fences helped the formation of the dunes. The fences consist of light brush panels 7 ft. long held together by battens at top and bottom and erected on posts driven into the sand. A single fence will cause the formation of a dune 20 ft. wide at the base, and by successive erection of additional fences on top of this dune and by placing the new fences on alternate sides of the original fence a height of 25 ft. and a base width of 150 ft. has been achieved.

Design Modernization and Cements Dominate Concrete Meeting.

This is a brief report of the thirty-third annual convention of the American Concrete Institute, held in New York from February 23-26, 1937. The convention was opened by two papers on European practice. Europe excels in bridges and the United States in dams. Manufacturing technique in Europe is behind that in America but nothing to compare with Freyssinet's 'treated concrete' is seen in America. This eminent French engineer has made piles and pipes using vibration, pressure to streach reinforcements, high temperature curing and pre-stressing. A series of papers on cement studies in which the most animated discussion centered on the Portland-puzzolan cements were presented. As a result of studies of concrete materials for the Passamaquoddy tidal power project it was found that Portland cements of medium high fineness and low calcium aluminate gave excellent strengths, were resistant to magnesium sulphate attack and had low volume change under freezing and thawing. Portland cements with high calcium aluminate could not withstand sulphate attack.

In a paper on the cement used in the spillway of Bonneville dam, experience with Portland-puzzolan cement has been discussed. This cement produces a very satisfactory concrete. Three papers cover the subject of concrete maintenance and repair. One of the papers describes the work of relining a canal on the Uncompahgre irrigation project in Western Colorado. Vibration studies of pavement concrete are presented in one of the most significant papers of the convention. Several design papers of note describing the foundation features and work on San Francisco Bay Bridge, structurse of New York World Fair, and the Palace of the Soviets in Moscow were also presented. The Joint Committee on concrete and reinforced concrete presented its progress report which was discussed.

Letters to the Editor.

Prof. Vierendeel in a letter to the editor says that the invention of the Vierendeel truss bridge dates back to 40 years when this type of bridge was first built in Belgium. During these forty years a hundred such bridges ranging from 100 ft. to 300 ft. in span have been built in Belgium. and the Belgian Congo. In this long period the system has been perfected from the technical and constructional standpoint. These bridges are twenty per cent. cheaper than the triangulated truss bridges. With Prof. Vierendeel's method, a Vierendeel truss of any type can be designed in one week without any trouble.

The Chief Forester of the Tennessee Valley Authority in a letter to the editor comments on an article 'River and Region' published in the Engineering News-Record dated December 24, 1936. He says that the problems of handling land now covered by forest, and stopping erosion in non-agricultural land are distinct from each other and were not represented as such in the original article. The forestry division of the Tennessee Valley Authority is engaged in the preservation and adequate development of the existing forest area. Attempt is also being made to stop gully erosion. Formerly the method in use was to build a large number of small check dams but the inadequacy of this method was soon realized and the present method is to construct diversion ditches to carry water at low gradients away from the upper end of gullies, and paved water channels to carry this water down to the stream beds below. Soil erosion prevention and control is a vegetative problem and the work done is meant to hold the soil long enough to let the vegetation establish itself. Forest land management as practised by the department is outlined in the concluding portion of the letter.

No. 10—March 11, 1937.

SAFEGUARDING SCHOOLS AGAINST EARTHQUAKES. Nibecker.
REPAIRING EARTHQUAKE DAMAGE. Byers.

These are the first two of a series of three articles on rehabilitation and rebuilding of schools in Los Angeles, California following the disastrous earthquake of 1933. In all cases of construction of new buildings and repairs to old ones special methods were employed to make the buildings resistant to earthquakes. The first article is a general discussion of the problem of safeguarding schools with which the public of Los Angeles were faced. The second article sets forth the five schemes of rehabilitation, describing the actual construction employed under each scheme in outline.

LARGE SEWER ON OCEAN BOTTOM HAS JOINTS OF NOVEL DESIGN.

The article describes an outfall sewer of 5 ft. inside diameter under construction in Los Angeles. A type of metal joint for concrete pipes is being used without going to the expense of an all-metal pipe, and the design is believed to be free from joint leakage and breakage. The use of pontoons for placing several sections at a time, arrangement of details to facilitate submarine construction, and variation of joint design to suit depth and bottom conditions are described, as also for construction operations.

THE RIVER'S RIGHTS.

The Editor in commenting on the floods in the Ohio Valley says that man's error has not been the neglect of flood control measures but his refusal to recognize the right of rivers to their floodways. There is little excuse for the water front location of thousands of properties damaged in the recent floods. Travelling down the Ohio during the recent flood, one could see scores of farm homes completely inundated though standing only a stone's throw from high ground. The federal government has never seen fit to establish flood flow boundaries for its rivers. People and Industries have been permitted to occupy normal flood channels, and flowageways have been restricted by filling in and by commercial development without protest by federal government. "In planning flood relief let us remember that the river has rights, and these rights must be respected."

CURRENT NEWS.

Voluntary removal to higher ground of those sections of Ohio Valley communities most subject to flood will be facilitated by a programme recently announced according to which government agencies will advance rehabilitation loans to the communities concerned.

In answer to claims made by the Jefferson County Grand Jury, the Chief of Engineers, U. S. Army has issued a statement denying that the navigation dams in the Ohio River had any effect on the height of the recent flood in Ohio. The Grand Jury held that the flood was caused by the dams in the Ohio River which have raised the bed of the river by several feet. The Chief of Engineers points out that the dams are constructed of shutters that are lowered flat on the bottom when the river rises. They have caused no deposit of silt because when the river carriers silt to any considerable extent, the dams are down. The recent disastrous floods were solely due to an extended period of heavy rainfall.

No. 11—March 18, 1937.

SEMINOE DAM.

I—SITE EXPLORATION AND DESIGN STUDIES. Keener.

II—CONSTRUCTION PLANT FOR SEMINOE DAM. Peugh.

This dam is being built on the North Platte River in Wyoming, U. S. A., for the Casper Alcova Irrigation Project, and generation of power. It will store water which will be let out into the river and will be diverted by the Alcova Dam for Irrigation. The first of the two articles describes the geological conditions of the site and the principal features of the dam. The dam is to be a concrete dam of the arched type. The crown section is 261 ft. high, 15 ft. wide at crest, and 85 ft. wide at the base. The upstream face is vertical and the downstream face has a batter of 0·268 to 1. The upstream face is laid out on a constant radius of 290 ft. and on the downstream side, the radii decrease progressively towards the abutments so that the horizontal section becomes wider as the abutments are approached.

Artificial cooling will be employed to reduce the temperature of concrete while setting. A grout curtain will be constructed in the foundation rock below the heel of the dam. A tunnel spillway through the right abutment of the dam is proposed. The tunnel will be 30 ft. in diameter and concrete lined throughout. The tunnel inlet will be controlled by electrically operated stoney gates. Release of water for irrigation down the river will be effected by two 72 inch welded steel pipes embedded near the centre of the dam.

The second article describes the construction plant in use. An aerial tramway 2½ miles long brings aggregate to the site from the quarry. Bulk cement is supplied and stored in Silos whence it is brought to the mixing plant by tramways. Concrete is placed by means of cableways.

CONTROL OF GREAT FLOODS. Morgan.

In this article, the Chairman of the Tennessee Valley Authority gives his views on flood control. He advocates examination of every possible method of solution of the problem of flood control including those which seem to offer very little promise. In a large flood control project, a single type of construction will rarely offer a solution. Floods cannot be mastered by levees alone or reservoirs alone, a combination of the two is most effective. Procuring of basic data of rainfall, run-off, stream capacities, storage areas, foundations etc. is of vital importance in flood control projects. Soil management, forestry, and reservoirs on headwater streams should not be ignored as means of flood control. An integrated system of river control for all purposes such as power, irrigation, flood prevention, navigation etc., is essential.

EXTERIOR WALLS OF CONCRETE HOUSE COMPLETED IN ONE DAY.

Use of a vacuum process by which excess water is speedily forced out of freshly poured concrete permits quick removal of forms followed by application of a stucco surface before final setting. This was demonstrated recently in Maryland, U. S. A., where the exterior walls of a bungalow 27 ft. by 37 ft. consisting of two 3 inch slabs separated by a 6 inch. air space were completed in one working day. The operations are described in detail.

PRACTICAL SOIL MECHANICS FOR SMALL DAMS. Doggett.

"In building some 30 small earth dams since 1928, the Indiana Department of Conservation has passed through an evolution in design and construction to practice representing the latest development of science in the disposition of materials, and in fill compaction. In their application to very small dam building these processes have a special interest, and an outline of practice is given here with a brief account of the character and purpose of these water conservation projects."

HOT WEATHER CONCRETING.

Work at the Imperial Dam on the Colorado River above low water level is ordinarily suspended between June 1, and October 1, owing to the extreme heat. The temperature in the shade often reaches 118°. By the use of certain simple expedients, concreting has been carried on safely under temperatures which would have made concreting impracticable otherwise. On this job a deep well supplies water at 70°F. for mixing during the hot weather. The aggregate bin is surrounded with a burlap covering on which water sprinkles continually. The mixer and the concrete delivery pipe are precooled by the same method.

EARTHQUAKE-RESISTANT DESIGN FOR NEW SCHOOL BUILDINGS. Bolin.

This article gives methods and details used in the new school buildings of wood, steel, concrete, and brick in accordance with California's structural law of 1933, the "Safety of School Houses Act" formulated after the disastrous earthquake.

EDITORIAL.

FLOOD PROTECTION AND THE MISSISSIPPI.

The Editor comments on the Mississippi Flood Control Project. He says that the Jadwin Plan of flood control limits the possible flood volume which has been demonstrated to be too small. The project is inadequate and requires a searching review. It is based on rejection of conservation and storage and must be revised.

No. 12—March 25, 1937.

DAY-LABOR STREET PAVING. Campbell.

Minneapolis, a city of nearly half a million inhabitants is carrying out all city construction work with its own engineering and construction forces and equipment, for the last 35 years. During this period an efficient system of paving organization, plant and technique of design and construction, has been developed, which is described herein.

ECONOMIC SIZES OF PRESSURE CONDUITS. Hinds.

This article sets forth methods of determining the most economical size of pressure lines. The procedure was developed in the design of the Colorado River Aqueduct which includes many syphons and force mains.

WELLS FOR THE WATER OF HAWAII. Stearns.

In Oahu, which is the third largest of the Hawaiian Islands, the principal source of water is artesian groundwater supply. This supply has been endangered by sea water contamination. A new type of well construction is being used now to minimize salt water contamination and permit increased development of the artesian basins. This method utilizes the artesian basin supply by skimming fresh water off the underlying layer of heavier sea water. The well consists of an inclined shaft from the ground surface to the water table level where one or more infiltration tunnels are extended horizontally at the zone of saturation. Pumps are used to elevate the water from the tunnels to the surface.

No. 13—April 1, 1937.

PAVEMENT DESIGN AND CONSTRUCTION IN MINNEAPOLIS Campbell.

This article is supplementary to the article entitled "Day-Labor Street Paving" in the previous issue and describes technique of construction and maintenance operations.

DRAINAGE BASIN PROBLEMS AND PROGRAMS. **Wolman.**

This is a summary of the drainage basin report of the Water Resources Committee outlining its principal features, limitations, and recommendations. The objectives of the committee are to determine the water problems, to outline the pattern of development and control which would solve the problems, and to suggest projects. Estimated costs of proposed projects are given in a table. The recommendations on major projects are outlined in brief. The committee's next endeavour will be to extend the investigation. (See also issue of the journal dated 15th April 1937, in this Bulletin.)

DETERMINING EVAPORATION LOSSES FROM WEATHER BUREAU DATA. Meyer. Levens.

Intelligent planning for water conservation demands consideration of evaporation losses. Mr. Meyer first published in 1915 a formula for computing evaporation. After considerable experience in this field of hydrology he has now derived some new coefficients for use in his formula. The formula has been verified by some independent investigations. A chart has been prepared based on this formula, from which the evaporation can be read off.

EXPERIENCE WITH LIGHT AGGREGATE IN CONCRETE CONSTRUCTION. McLean.

Light weight aggregate was used exclusively except for foundation piles in a two storey commerce building in California. The foundation conditions were poor and it was necessary to lighten the deal load by using light weight aggregate. The aggregate was made from a low grade diatomacious earth containing a small amount of clay. Grading of aggregate mixing concrete, and placing are described. Results of compression tests are tabulated. Costs of light weight aggregate and ordinary concrete are compared.

No. 14—April 8, 1937.

LARGE CONCRETE SHELL ROOF COVERS ICE ARENA. Tedesko.

Describes a thin concrete shell roof 3½ in. thick supported by two-hinged arches for a skating floor 340 ft. long and 232 ft. wide. Details of design and reinforcements are given and the construction procedure is described.

WHEN EXTRAS ARE ALLOWABLE AND HOW TO GET THEM. King.

"Few questions in engineering construction have led to more frequent dispute than claims and allowances for extra

work. In many actions at law to which these disputes have come, the courts have handed down decisions of utmost importance to contractors".

In construction work alterations and additions are almost certain to be required during the progress of the work. The procedure to be considered in handling such changes in mutual justice is the subject of this article. A number of typical illustrative cases of dispute and the decisions thereon are given. Other points of dispute which are likely to arise are discussed in detail and decisions are recommended. After reviewing the question from all possible angles, the writer who is an attorney, has drawn up a number of rules for claiming extras which should prove useful to contractors.

MODERNIZING AN OLD CONCRETE ROAD WITH MAXIMUM SALVAGE. Saville.

Two recent resurfacing operations by the Missouri State Highway Department are described in this article as examples of modern road treatment. One operation was Portland cement concrete resurfacing and the other was asphaltic concrete resurfacing. The original pavement was a Portland cement slab badly broken.

WIDENING AN ANCIENT STONE BRIDGE FOR MODERN TRAFFIC.

Iena Bridge in Paris is 122 years old. This is a stone arch bridge 49 ft. wide. Recently, its width has been increased to 95 ft. The new wider bridge has been obtained by building new reinforced concrete arches on entirely separate foundations on each side of the arches of the existing bridge, and spanning the spaces in between with steel floor beams.

No. 15—April 15, 1937.

CONCHAS DAM AND RESERVOIR PROJECT. Noyes.

The Conchas Dam is being built across the South Canadian River in New Mexico. The reservoir formed by the dam will store water for irrigation and will also act as a flood control reservoir. This article gives a history of the project and describes the basin of the South Canadian River the upper portion of which is subject to floods causing great damage. The work was started in August 1935 and is scheduled for completion in 1939. The construction camp is described in detail. Hydrologic studies of the river basin undertaken to determine the necessary capacity of the reservoir are described. A balanced allocation of storage was decided upon to satisfy demands of flood control and needs of irrigation. The dam will be a concrete gravity structure 235 ft. high, 1250 ft. long, with an overfall spillway 340 ft. long, located in the main body of the dam. The geological conditions of the dam site are described. The total capacity of the reservoir is 500,000 acre ft. The capacity up to spillway crest level is 300,000 acre ft. and this is allocated to irrigation. Provision has been made to increase irrigation storage by 100,000 acres ft. by the future installation of automatic gates on the spillway. The project will also require the construction of about 13,650 ft. of dams and dykes composed of earth embankments. A concrete overfall weir 3,000 ft. long will form an emergency spillway and will be a separate structure 2,000 ft. to the north of the main dam.

ROADSIDE EROSION CONTROL STUDIED BY SOIL CONSERVATION SERVICE.

Davis.

In the states of Louisana, Arkansas and Texas there are over 500,000 miles of roadside ditches in the design of which no consideration was given to the problem of erosion. The sides and bottom of these ditches are badly scoured by rushing rain water. The soil conservation service is planning to construct a number of highway control demonstrations. Methods to be demonstrated include proper design of waterways for desired velocities, growing vegetable cover on the slopes of ditches, use of intercepting terraces on non-erosive grades, and use of masonry drop inlets to divert outside water into the waterways.

HOLLOW CONCRETE RIGID FRAMES SUPPORT AUDITORIUM ROOF.

Wright.

Describes a hollow girder roof supported by hollow columns of reinforced concrete recently built for a school auditorium in California. The span is 77 ft. and the columns are 26 ft. high. Details of the hollow columns and girders are given and construction methods are described.

NOMOGRAPHIC RELATIONSHIP OF HYDRAULIC FRICTION FACTORS.

Overshiner.

In dealing with hydraulic problems involving flow of water through pipes or conditions, one of three formulæ is generally used. These are the Chezy formula, the Manning formula, and the Weisbach formula. Each of these formulæ involves a coefficient. It occasionally becomes necessary to know the value of one of these coefficients corresponding to that of another. The relation between these coefficients can be expressed by two equations. A nomograph has been prepared which gives a ready solution of these equations for all cases likely to be met with in practice. An example illustrating the use of the nomograph is given.

RIVER RESOURCE MANAGEMENT.

Editor's comments on the report of the Water Resources Committee on the drainage basin survey accomplished in the U. S. A. When the administration asked for the survey, it expected to obtain a ready-made programme for a national construction campaign, but the survey has produced no such result. The survey is a listing of a number of projects affecting river use and abuse, and in addition, a partial sifting and co-ordination of these projects. The listing is incomplete. The report is only a preliminary index of future river development problems and undertakings. The survey points to two conclusions. Firstly, intensive study of each basin and each problem in that basin must follow the present survey. Secondly, a means of continuous correlation of State and Federal authorities must be established. A permanent bureau or board should be set up operating under a code of objectives and principles laid down by the Congress.

CURRENT NEWS.

A large installation of a central water cooling plant for air conditioning of a number of separate buildings is under construction in Washington. The 6,000 H. P. plant will have a water cooling capacity of 8,000 gallons per minute to a temperature of 40°F.

No. 16—April 22, 1937.

SQUEEZE TEST FOR INTEGRITY OF SOIL SAMPLES. Burmister.

Samples of soil which are taken in the field and transferred to the laboratory for the study of undisturbed soil, are always subject to a certain amount of disturbance during handling and transit. A method of selecting the least disturbed sample in the laboratory has lately been developed and has been called the squeeze test. The device used for the test and the procedure are described in this article.

SERIOUS LEAK CHECKED IN COFFERDAM AT GRAND COULEE.

Serious leaks occurred through the base of the Cofferdam which keeps the Columbia River out of the area in which the east section of the Grand Coulee Dam is being built. One cell of the Cofferdam collapsed as a result of this leakage.

Steps were taken to check the inflow and protect the area within the Cofferdam. These are briefly described. Later, a plan for strengthening the Cofferdam, and stopping the leak was decided upon and has been put under construction. The plan consists of building an auxiliary ring of gravel filled sheet pile cells, seven in number, the intervening space between the old and new cells being filled with sand and gravel. Timber cribbed drainage wells will be placed behind the auxiliary cells so as to reduce the flow of water sufficiently to permit effective grouting of the leaks. An experimental model has been built and experiments are being carried out to determine the best material for grouting.

No. 17—April 29, 1937.

(City Engineering Number.)

NEW STREETS FOR OLD.

Factors which should govern modern road design are discussed in this article. Streets must be designed to move traffic as speedily as possible with the highest degree of safety to everyone. Street surfaces can no longer be made smooth but must purposely be roughened to increase friction between the tyre and the pavement. The recently developed de-aerated vertical fibre paving bricks, the practice of removing surplus bitminous filler from the surface of brick payments sand paper finish on concrete payments, and the open type of bituminous surface, are modern examples of non-skid road surface construction. Intersection design, lighting and devices for the safety of the pedestrian, are discussed.

STREET MAINTENANCE. Shafer.

Street maintenance methods as adopted in the State of Pennsylvania are described in this article. The satisfactory maintenance of dirt roads is one of the major problems. The method of surfacing them consists of covering them with a light layer of air cooled slag and treating with an asphalt dust layer afterwards. The resulting surface is smooth and hard, and more or less moisture proof.

No. 18—May 6, 1937.

HYDROMETER COMPUTATIONS IN SOIL STUDIES SIMPLIFIED. **Bauer.**

The determination of the percentages of the various sizes of soil particles smaller than the No. 200 sieve made quite generally by the hydrometer method. One type of hydrometer developed by Casagrande measures the density of the suspension at some depth below the surface. The formula relating the diameter of the particles to the specific gravity of soil, specific gravity, and viscosity of the liquid used in the suspension, and other factors, is a complicated one and involves lengthy computation. The writer of this article has prepared tables for facilitating the computations which are presented. An example, illustrating the use of the tables is given.

NEW CREST GATE FOR DAMS. Bauknight.

Emsworth Dam on the Ohio river which is a navigation dam is under reconstruction. The present dam is a fixed dam founded on timber piles. The new dam which adjoins the old one on the upstream side is founded on H section steel bearing piles 30 ft. long. The old dam will serve as an apron and baffle below the new section. The new dam consists of a fixed section and a number of piers for vertical lift gates working between the piers. As the river channel is divided into two sections by an island, the dam is also in two sections. In one of the sections there are 8 vertical lift gates. In the other section there are 6 gates of which 5 are the ordinary vertical type lift gates and one is a special type of gate called the Sidney gate. (All the gates are 11 ft. deep by 100 ft. long.) This gate could be described as a combined radial and lift gate. It tilts to part opening by revolving and then lifts vertically to the height required to clear the opening. The gate is triangular in cross section, the upper and lower legs are trusses and the upstream face consists of a girder. The skin plate forms a segment of a circle. The advantages of this type of gate over the tainter and the vertical lift gates are compared and the comparative weights of the three types of gates are given.

LATERAL LOADING TESTS MADE ON STEEL BEARING PILES. Vierheller.

Describes the procedure adopted for tests on large H section piles driven about 30 ft. into sand and gravel underneath Emsworth Dam to determine what lateral loads could be assumed in the design of the structure.

No. 19 —May 13, 1937.

LARGE STEEL PENSTOCK PLACED IN TUNNEL AT FORT PECK. Pence.

Describes the erection of a steel pipe 24 ft. 8 in. in diameter inside tunnel No. 1 of the Fort Peck Dam. The tunnel is 32 ft. 2 in. excavated diameter, braced with structural steel ring beams and purlins, and lined with 21-inch thick concrete thoroughly grouted into the rock. Inside this has been placed a tube 24 ft. 8 in. in diameter made of riveted steel plate of 1 inch thickness. Between the steel tube and the concrete lining is a space 23 inches wide which has been filled with concrete and grout. Fabrication of the steel tube, assembly, and placement are described, together with the filling of concrete behind the pipe.

MODERN BUILDING DESIGN FOR A SMALL TOWN NEWSPAPER.

A newspaper building incorporating air conditioning, indirect lighting, exterior walls partly built of glass blocks, acoustical insulation, and glazed tile wall interiors has recently been completed in Iowa city. The air condition unit has been designed for automatic heating and humidifying of air in winter, and cooling and dehumidifying in summer. The air throughout the building will be changed every 20 minutes.

MEASURING SOIL MOISTURE.

Ehrenburg.

The U. S. Bureau of Reclamation laboratories in Denver have developed a portable electric instrument to determine the moisture content of sand and soil. The instrument is known as a moisture meter and was tested for two purposes : (1) control of moisture content of soil in earth dam construction and (2) determination of moisture content of sand for use in concrete. The results of the tests are discussed and it is concluded that the moisture-meter offers a quick and accurate method of determining the moisture content of soil and sand provided the material is uniform in composition and grading.

MARSHALL FORD DAM DESIGNED FOR RAISING IN FUTURE.

The Marshall Ford Dam being built by the U. S. Bureau of Reclamation on the Colorado River is designed for two-stage construction. The first stage construction provides for a concrete gravity dam 190 ft. high and 2,325 ft. long with an overflow spillway 730 ft. in length. The left end of the dam will be flanked by a rolled earth embankment 1,100 ft. long and 30 ft. high with a low concrete cut-off wall inside it. The dam will ultimately be raised to a total maximum height of 265 ft. The dam will be raised by widening on the upstream side while the place of the sloping front or downstream side of the dam will be extended upwards.

CURRENT NEWS.

EARTHQUAKES AT BOULDER DAM.

Earthquakes at Boulder Dam have been frequent of late. Sounds like explosions accompany the quakes. Because of the frequency of shocks since lake Mead has begun to fill and the inference that this new water load on the earth's crust may be causing the quakes, it has been suggested that the U. S. Coast and Geodetic Survey should instal a group of instruments for a regular study of these seismic disturbances.

No. 20—May 20, 1937.

COFFERDAMMING DIFFICULTIES IN A NARROW TIDEWAY. Albertson.

A new bridge is being erected to replace an old one at the mouth of the Shark river on the New Jersey coast in U. S. A. The foundation work was complicated by tidal currents, and obstructions in the shape of the old piles of the demolished bridge. Special methods were adopted for putting in the pile foundations of the piers. The Cofferdamming operations, method of dealing with the old piles and driving of new piles are described.

LAMINATED TIMBER ARCHES SUPPORT MUNICIPAL AUDITORIUM ROOF.

A special type of timber arch was used for the roof of a municipal building at Jamestown, U. S. A. Ten arches of 120 ft. span were put up in the 200 ft. length of the building; each arch consists of two flanges, with a web in between. Each flange consists of 8 planks 1 inch by 12 inches while the web consists of two stacks of 4 inch by 3 inch timbers, the whole held together by ⅝ inch machine bolts 2 ft. long. Assembly and erection are described.

WELDED ROAD BRIDGE GIRDERS BUILT ON 70 FT. SPAN. Bloch.

Welded plate girders 71 ft. 8 in. long—the longest in America—and 72 inches deep were used in a highway bridge in New York county. The design is described in brief.

FORT PECK SHAFT LINING. Pence.

Under the right abutment of Fort Peck Dam, there are 4 tunnels 24 ft. 8 in. in diameter through which the Missouri river will be diverted. Near the axis of the dam each tunnel is intercepted by a 50 ft. diameter main shaft that will house the cylinder gates by which the flow past the dam will be regulated. These shafts were excavated 60 ft. in diameter and are lined by a 5 ft. shell of reinforced concrete in which is embedded a welded steel plate cylinder. This article describes the details of the lining and outlines the procedure of construction.

STEEL PIPE 11½ FT. IN DIAMETER WELDED BY IMPROVED METHODS.

On colorado river aqueduct steel pipes 31/32 in. thick are being welded in place in the trench. The inner surface is being enamelled while the outer surface is being protected with 'shotcrete' or concrete forced under pressure. The details of the methods employed are described in this article.

No. 21—May 27, 1937.

FORT PECK DAM CLOSURE SLOPES DRAINED BY PERFORATED METAL PIPES.

The Fort Peck hydraulic fill earth dam is being built in two sections one on each bank of the river. The slopes of the fills facing the river are called closure slopes. Seepage from the closure slopes developed some time ago and the slopes became unstable at the toe. Perforated pipe drainage systems were installed with very successful results.

FINDING GOOD SUBGRADE MATERIALS.

The Arizona Highway Department is conducting tests to develop a test measure of the stability of subgrade materials. This article describes the apparatus used, and the method of testing.

PARTIAL FLOOD-CONTROL STORAGE VALUABLE IN EXTREME HIGH WATER. Grimm.

Reservoirs for flood control usually have great value over a long period of years even though their capacity is not sufficient for full control of the larger floods. This point is illustrated in this article with the help of two diagrams which refer to a portion of the Willamette River flood plane that would be benefited by a system of reservoirs, now under consideration.

VEHICLE TUNNEL TO BE BUILT UNDER MASS RIVER AT ROTTERDAM, HOLLAND.

Gives the principal details of a tunnel to be constructed. The tunnel will be of rectangular design with two traffic channels, one for vehicles and the other for bicycles and pedestrians. The portion of the tunnel under water will be prefabricated in 229½ ft. long sections on the shore and will be sunk and connected up in the water. The shell will be lined with 1·64 ft. of reinforced concrete.

JOURNAL OF THE AMERICAN WATER WORKS ASSOCIATION.

VOL. 28.

No. 4—January 1937.

DESIGN OF EARTH FILL DAMS. Wyckoff.

This article sets forth in general terms, the principles governing the design of an earth fill dam, and the factors to be considered in order to evolve a safe design. The cross sectional dimensions of a dam are governed by the stability and perviousness of the foundation material as well as the material in the fill. Detailed study and laboratory tests of foundation material at various depths are the first essentials. The plasticity under a saturated condition and the percolation rate should be determined for the foundation soil. The rate of percolation through the material of the fill should also be determined by laboratory tests. The upstream slope should be flat enough to prevent sloughing of the material in the reservoir when the reservoir is suddenly emptied and the slope of the line of percolation is reversed. The protection of the upstream face from wave action is also necessary. Cut-off walls are useful if they can be extended to some formation more impervious than the one on which the dam rests. If the dam rests on rock, grout holes are necessary in the vicinity of the upstream toe to seal fissures in the rock. Considerations affecting the design of outlet works are briefly discussed.

SOIL COMPACTION CONTROL FOR ROLLED EARTH DAM CONSTRUCTION.

Proctor.

Many engineers consider soils for earth dams on the basis of watertightness alone without regard to the extent to which the soil should be compacted to resist softening from saturation. The saturated plasticity of the compacted soil is however much more important than watertightness alone. As a result of tests conducted by the author, he found that specimens of a particular soil that were compacted at the highest and lowest moisture contents were the most pervious, while specimens of the same soil compacted at an intermediate moisture content were impervious in the desired degree. The procedure of determining experimentally the maximum moisture content and plasticity that should be permitted during compaction is described in this article.

JOURNAL OF THE AMERICAN SOCIETY OF AGRONOMY.

VOL. 28.

No. 4—April 1936.

STUDIES ON THE USE OF THE TERRACING PLOW FOR SOIL CONSERVATION.

Harper.

The terracing plough is an implement to build terrace ridges which protect the soil from erosion by reducing the quantity of run-off of water. Studies were made to determine the limitations of this implement in a soil conservation programme and the results are presented.

PHYSICS.

VOL. 7.

No. 3—March 1936.

SOME APPLICATIONS OF PHYSICS TO AIR CONDITIONING. Pugh.

The term air conditioning is applied to the cleaning of air and to the control of its humidity and temperature. This article deals with temperature control. The "heat pump" system of heating a building is discussed In this system, the same equipment can be used for both heating and cooling. The use of this system is however limited to milder climates or to locations where plenty of water is available. In the design of cooling systems, the nature of heat flow into a building needs detailed consideration. Average flow of heat through a wall, the maximum heat flow. and the time of arrival of this maximum heat flow require to be accurately determined. The author has indicated a graphical method of determining the above factors based on a mathematical solution of the problem by the author. A typical curve showing the variation with time of the temperature of the surface of roof panels exposed to the summer sun is also included. Experiments were conducted by the Research Bureau of the American Society of Heating and Ventilating Engineers to determine the relations between internal surface temperatures and temperatures of the external surfaces exposed to the sun, and also the time lag of maximum internal temperatures behind the maximum external temperatures. The results are presented in the form of curves.

THE SEEPAGE FLUX UNDER DAMS OF EXTENDED BASE WIDTH AND UNDER COFFER DAMS RESTING ON PERMEABLE STRATA OF FINITE THICKNESS I. Muskat.

In this article, an exact theory is given of the seepage flux underneath dams of extended base width, with and without sheet piling, and under coffer dams with variable depths of excavation on the downstream side. Three cases are dealt with, *viz.* (1) dams of extended base width and no sheet piling, (2) dams of extended base with sheet piling and (3) coffer dams. In each case, an equation for the seepage flux per unit potential drop has been derived by a process of mathematical analysis based on the method of conjugate functions. Curves have been plotted based on the equations derived giving the seepage flux in terms of the ratio of dam width to thickness of permeable stratum, the depth and position of piling, and depth of penetration of coffer dam. Curves showing pressure distribution at the base of dams with and without sheet piling are also given. Conclusions arrived at may be summed up as follows. The effectiveness of sheet piling in cutting down the seepage flux is a maximum when it is set at the heel or toe of the dam, and increases as the ratio of the thickness of the permeable stratum to the dam width increases. Although the flux decreases with increasing piling depth, a large portion of flux persists till the piling penetrates to the very bottom of the permeable stratum.

PROCEEDINGS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

Vol. 63.

No. 3—March 1937.

This issue contains a symposium on National Aspects of Flood Control consisting of the following papers :—

Federal responsibility for flood control. Davis.

The importance of the problem of flood control and the need for national control and action are brought home to the reader in this article. Conditions in the state of Pennsylvania are discussed as typical of those elsewhere in the U. S. A. and arguments for Federal responsibility in flood control are cited.

Problems in developing a national flood-protection policy. Wolman.

In this article the writer discusses some aspects of national flood protection policy such as engineering, financial and administrative aspects and suggests the lines of approach to the development of a national flood protection policy. He has attempted to show that the development of a national flood protection policy should not be separated from that of a national water resources policy in general. A few undertakings are briefly described as examples of multiple use of streams.

The economic aspects of flood control. Jacobs.

"Flood control is a problem of applied economics in which the social security and protection of life and property must be evaluated in balancing the annual savings from flood control against the cost of construction and maintenance". The writer discusses social security as a factor in evaluating flood control. The Flood Control Act of 1936 lays down that it is proper for the Federal Government to participate in flood control projects if the life or social security of the people is in danger. The economic problem of flood control involves the question of selecting the most suitable type of works for flood control. The question of reservoirs for flood control alone, and multi-use reservoirs is discussed. The benefits of flood control, direct and indirect, are set forth, and the question of distribution of costs of a flood control project is discussed.

FLOOD CONDITIONS IN NEW ENGLAND. Uhl.

This article describes the topography of New England and the two most disastrous floods which occurred in 1927 and 1936. The two floods are compared and the flood damages are evaluated. The question of prevention of flood damages by flood warnings, is discussed and suggestions are made to improve the service of the U. S. Weather Bureau which is responsible for flood warnings. Flood control works are then dealt with and the effectiveness of storage reservoirs for flood control is discussed. The working of two detention reservoirs is examined and it is concluded that these reduced the peak flow of the river by about 16 p. c.

THE NEW YORK FLOODS OF 1935 AND 1936. Harrington. Johnson.

This paper describes the major drainage basins of New York state and describes the causes contributing to the occurrence of the floods of July 1935, and March 1936. The floods have emphasized the importance and value of basic hydrologic data. There is an insistent popular demand for flood control in the State as a result of the two floods in 1935 and 1936. The limitations imposed by nature on flood control projects are mentioned.

FLOODS IN THE UPPER OHIO RIVER AND TRIBUTARIES. Morse. Thomas.

"The object of this paper is to describe the outstanding characteristics of the unprecedented floods of March 1936 in the upper Ohio River and its tributaries, to point out the causes which combined to bring about the occurrence of this flood, and to outline the history of the present flood control programme for these rivers. Recommendations are made for improving the facilities and technique used in forecasting floods in this region."

AN IDEAL ORGANIZATION FOR THE RIVER AND FLOOD SERVICE OF THE UNITED STATES WEATHER BUREAU. Hayes.

The demand for flood forecasts has grown rapidly as the result of frequent floods and the standard of accuracy of such forecasts demanded is constantly increasing. This necessitates additional observations and better methods of prediction. The writer has advanced a plan for improving the river and flood service of the U. S. Weather Bureau which essentially consists of more rainfall observation stations, surveys of amount and condition of snow in the mountains, arrangements for a more reliable transmission of rainfall and riverflow records from substations to the district centres and forming a number of sections of the country for river administration.

FEDERAL PLANS FOR FLOOD CONTROL. Covell.

The Mississippi River basin is the largest drainage basin in America. The first flood protection sponsored by the Federal Government was in this valley. The history of flood control on the Mississippi River is outlined, and the gradual extension of Federal interest in flood control to other localities is reviewed, leading to the Flood Control Act 1936 which represents national planning on a country-wide scale. The project for the Ohio River basin authorized by the Flood Control Act of June 22, 1936 is described in detail. The general features of the reservoir system which contemplates control of flood waters at or near their source are presented. An abstract of the Flood Control Act of 1936 is given in an appendix.

PROGRESS REPORT OF THE COMMITTEE ON FLOOD PROTECTION DATA.

The Committee on Flood Protection Data presented its progress report for 1936 at the annual meeting of the Institution in January 1937. The report describes the flood studies undertaken. The recommendations of the Committee with regard to the steps to be taken to alleviate flood damage and the compilation and publication of flood data are set forth.

No. 4—April 1937.

THE PASSAGE OF TURBID WATER THROUGH LAKE MEAD. Grover. Howard.

Turbid water carrying a considerable load of fine silt was discharged from Lake Mead above Boulder Dam at three different periods during 1935. The turbid discharges represent the conveyance through and the discharge from the lake of as much as 6,000,000 tons of silt. There is evidence to show that silt laden water flowed through the reservoir essentially unmixed with the clear water in the reservoir. The phenomenon is ascribed to the greater specific gravity of the incoming water relative to the generally clear water at the surface of the lake. The loads of suspended matter carried by the Colorado River are computed for two gauging stations, one 265 miles above the dam and the other 10 miles below it. The loads in tons per day carried at the two stations are represented graphically. A study of the curves shows that the flow of turbid water followed an increase in suspended matter recorded at the gauging station 265 miles above the dam. The flow also depended on the size of silt articles carried in suspension into the lake. It was only when the silt load carried into the lake was very fine that turbid water flow was observed below the dam.

The authors suggest that a study of conditions pertaining to the flow of silt through a reservoir is of great importance, as one of the unsolved problems of detention reservoirs relates to the gradual loss of capacity due to silt deposit. If means could be found whereby a considerable quantity of silt could be discharged out of the reservoir, its effective life would be increased.

PRACTICAL USE OF HORIZONTAL GEODETIC CONTROL. Sheldon.

"An argument for the increased use of the horizontal geodetic control system is offered in this paper. It contains suggestions to the engineer when he is beginning to use this control, a description of the origin and use of this system which has been followed successfully in the Panama Canal, and an analysis of the errors developed by using this system of control in the canal and other zones". The writer concludes that plane surveying is out of date, and the system described is a valuable aid in performing all kinds of field engineering work.

PRESSURES BENEATH A SPREAD FOUNDATION. Krynine.

Part I of this paper describes a graphical method of determining pressures under foundations with uniform and non-uniform loads and is called the reduced area method. Part II deals with pressures under rigid foundations.

No. 5—May 1937.

EARTHQUAKE RESISTANCE OF ELEVATED WATER-TANKS. Ruge.

The problem of building an elevated tank which is truly earthquake resistant is considered in detail in this paper. A new design is put forward as a practical solution. Experimental work with models to study the stresses developed in a water tank due to vibration are described. Reproductions of actual earthquake motions were applied to models in the experiments. The result show that dangerous stresses are not avoided by designing against a statical horizontal force as is generally assumed to allow for earthquakes. Rules for the design of structures of the new type suggested are given.

HYDRAULIC TESTS ON THE SPILLWAY OF THE MADDEN DAM. Randolph.,

Madden Dam on the Chagres River in the Isthmus of Panama is being built to create a reservoir for storing water to be used for lock operation and for flood control. The main dam is of mass concrete gravity type 974 ft. long at crest and 220 ft. high, consisting of an overflow spillway section across the river with abutment sections on either side. The spillway is divided into four 100 ft. openings, and structural steel drum gates are installed on the concrete crests in these openings. The flood water passing over the spillway has a drop of 173 ft. to the toe and the velocity will be 100 ft. per second. It was found necessary to devise means of dissipation of this energy to eliminate erosion of the foundation rock.

Tests were made on a model of the dam built to a scale of 1 : 72 with various types of aprons including dentated sill apron and hydraulic jump apron of the level and sloping type and the last named was found to be the most effective. Detailed analysis of the experimental results has been made. Tests were also made with the model of other features of spillway design such as spillway retaining walls, drum gate operation, location of sluice ways through the spillway section, shape of deflecting lips over sluiceway exits. Conclusions arrived at from the results of the tests are set forth.

In order to check the model predictions test apparatus was installed at the dam itself and tested. The results obtained are described and are found to be consistent with the predictions made from the model tests.

READJUSTMENT OF TRIANGULATION DATUM.

Describes some methods of readjustment of an old triangulation to fit a new datum by applying corrections to old datum values.

DISCUSSIONS ON THE FOLLOWING PAPERS APPEAR IN ONE OR MORE ISSUES OF THE PROCEEDINGS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS GIVEN ABOVE :—

VARIED FLOW IN OPEN CHANNELS OF ADVERSE SLOPE.

ADMINISTRATIVE CONTROL OF UNDERGROUND WATER : PHYSICAL AND LEGAL ASPECTS.

BACK-WATER AND DROP-DOWN CURVES FOR UNIFORM CHANNELS.

DYNAMIC DISTORTIONS IN STRUCTURES SUBJECTED TO SUDDEN EARTH SHOCKS.

ANALYSIS OF VIERENDEEL TRUSSES.

SIMPLIFIED METHOD OF DETERMINING TRUE BEARINGS OF A LINE.

SELECTION OF MATERIALS FOR ROLLED-FILL EARTH DAMS.

STRUCTURAL APPLICATION OF STEEL AND LIGHT-WEIGHT ALLOYS: A SYMPOSIUM.

ECONOMIC DIAMETER OF STEEL PENSTOCKS.

RECLAMATION AS AN AID TO INDUSTRIAL AND AGRICULTURAL BALANCE.

SURFACE AND SUB-SURFACE INVESTIGATIONS, QUABBIN DAMS AND AQUEDUCT: A SYMPOSIUM.

INTERACTION BETWEEN RIB AND SUPERSTRUCTURE IN CONCRETE ARCH BRIDGES.

STRESSES AROUND CIRCULAR HOLES IN DAMS AND BUTTRESSES.

DEFLECTIONS BY GEOMETRY.

FLOW CHARACTERISTICS IN ELBOW DRAFT-TUBES.

RAINFALL INTENSITIES AND FREQUENCIES.

STABLE CHANNELS IN ERODIBLE MATERIALS.

CONSTRUCTION AND TESTING OF HYDRAULIC MODELS, MUSKINGUM WATER-SHED PROJECT.

GRAPHICAL DISTRIBUTION OF VERTICAL PRESSURE BENEATH FOUNDATIONS.

THE RECLAMATION ERA.

VOL. 27.

No. 2—February 1937.

BOULDER DAM PLAYS ITS PART IN RECLAMATION. Young.

This article is a brief review of the objects of the Boulder Dam and the benefits which have resulted from its construction. The Colorado river in its lower reaches flows across the hottest and driest part of the U. S. A. Without regulation, the river was of little value to this lower basin area. The quick run-off and the absence of summer rains made any large irrigation development impossible. Moreover, the floods in the river were a menace to life and property in the area. There was a constant demand for a secure water supply and protection from flood menace which compelled the attention of the Federal Government and resulted in the construction of the Boulder Dam. The benefits which have accrued from the project are:—

1. Control of floods. The upper 72 ft. of the reservoir having a capacity of 9,500,000 acre feet are reserved for flood

control purposes and is not to be encroached upon for storage of water.

2. Provision of adequate water supply.
3. Silt control. The Colorado transports silt to the delta past a given point at the rate of 330 tons per minute. This silt will be trapped to a very large extent in the reservoir.
4. Improvement in navigation will be made by conditions of regulated discharge provided by the storage.
5. Generation of Power.

DIVERSION OF COLUMBIA RIVER—GRAND COULEE DAM. Markhus.

This article describes the operations in connexion with the diversion of Columbia river for building the centre section and east end of the Grand Coulee Dam. The operations include construction of two cross river coffer-dams, removal of upstream and downstream wings of the west side coffer dam and providing a channel for the diverted river.

HYDRAULIC MODELS AID DESIGN OF RECLAMATION STRUCTURES. Barnes.

The study of hydraulic models in connexion with design of spillways, gates, transitions and other structures affecting control of water has come into general use in the U. S. A. within the past 6 or 7 years. Of 21 laboratories listed in the October 1935 bulletin of the National Bureau of Standards only 5 or 6 were in existence before 1930. Three of the new laboratories are operated by the Bureau of Reclamation. Some of the problems studied such as determination of approach and crest shapes of spillways, efficiency tests of turbine models etc. are quantitative. Studies of stilling pools, transition sections, scour below sills, and the like are comparative. Complete similarity between model and prototype is mathematically and physically impracticable. The major technical problem in applying model studies to design work is one of properly interpreting and allowing for unavoidable dissimilarities. The principal materials for models used in the reclamation laboratories are wood, sheet metal, cement, plaster and pyralin. The last named material has come into use recently. It is clear sheet celluloid which can be fastened at the edges to wood with screws or welded with acetone. It has a visibility as good as glass and can be drilled through without cracking. It permits of a motion picture of the flow being taken. In the cases of such important works as the Imperial Dam and the Grand Coulee Dam the designs were largely influenced by hydraulic model studies.

No. 3—March 1937.

Water Conservation and Control.

Page.

This is an address delivered by Mr. John C. Page, Commissioner of Reclamation in San Antonio, Texas. The importance of the conservation and control of water is emphasized. The work of the water resources committee of the National Resources Committee is reviewed. The collection of reliable hydrological data is of great importance for water control projects. The peculiar problem of Western America was that of irrigating its arid lands. The Water Resources Committee included in its recommendation list of projects in which the Bureau of Reclamation is interested. All projects since completed by the Bureau or in progress are included in the list. Boulder Dam is one of such projects. It is an example of the new type of Western water project. The Bureau of Reclamation is at present engaged in its largest construction programme consisting of seventy two contracts.

The Art of Pressure Grouting.

Minear.

This article describes the grouting work done at the Boulder Dam. The work consisted of grouting of contraction joints, and grouting of foundations. The methods, and the equipment employed are described (See pages 72 and 76 of Bulletin No. 5).

Foundation Exploration with 36-inch Drills.

A recent contribution to exploration work is the large diameter core drill which drills smooth walled holes sufficiently large in diameter to permit the engineer or geologist to enter the hole and examine the exposed section of the rock in place. Drilling is done by a rotating cylinder. The core is broken loose at the bottom of the hole by small charges of explosives inserted at a few points in the bottom of the circular cut, or by wedges driven between the core and the side wall of the hole. The core is lifted by means of a cable sling around the core. If the core is too friable to be removed intact, sections of the core are broken and removed by a large auger. The Bureau of Reclamation has used 36 inch diameter core drills with advantage on some of its large projects. Drilling costs are given. The drilling operations at Friant and Kennett Dam sites, Central Valley Project, California, the Hamilton Dam, and the Marshal Ford Dam are briefly described.

No. 4—April 1937.

Dedication of Marshall Ford Dam, Colorado River Project, Texas.

Addressed delivered by the Secretary of the Interior, U. S. A. on the occasion of the celebration of the beginning of work on Marshall Ford Dam. The dam is being built mainly for control of the river and protection from floods. It will be a concrete gravity dam, 2,325 ft. long, 190 ft. high and will create a reservoir with a capacity of 600,000 acre ft. It will be built in 2 stages. The ultimate height of the dam will be 265 ft. and with this height it will store 3,000,000 acre ft. Some other structures being constructed by the Bureau of Reclamation are briefly referred to.

Parker Dam, Half Completed, serves useful purpose.

The Parker Dam is in course of construction on the Colorado River. Excavation for foundations of the dam was in progress behind two temporary cofferdams by which the river was diverted to flow through two tunnels. At this stage a big flood occurred on the Colorado and the Cofferdam was raised and strengthened immediately. More than 50,000 acre ft. of water was impounded at the dam site. The effect of the flood was not felt below Parker Dam site.

Central Valley Project.

The Central Valley Project is designed to provide better distribution of water in the two valleys of the Sacramento and San Joaquin Rivers in California. The primary purposes are to supply irrigation water in the San Joaquin Valley where agriculture is endangered by depletion of underground water supplies and to increase the low flow of the Sacramento river to prevent encroachment of salt water from San Francisco Bay upon the Sacramento San Joaquin Delta. There will be two storage on the two rivers.

No. 5—May 1937.

Salt River Delegation Visits Bartlett Dam Site.

Koppen.

A group of 100 people including the Board of Governors visited the site of the Bartlett Dam to celebrate the placing of the first concrete. Bartlett Dam is being built to develop 242,000 acre of farm land in the Valley of the Sun, and will harness the floods on the uncontrolled Verde River and make the water available for irrigation. It will store

200,000 acre ft. and will be a multiple arch dam 270 ft. high, with 10 arches of 60 ft. span with two short gravity sections at each end, the total length being about 800 ft. The spillway will have a capacity of 175,000 cusecs, and the discharge will be controlled by three 50 ft. by 50 ft. fixed wheel gates.

POWER DEVELOPMENT ON FEDERAL RECLAMATION PROJECTS.

In this article, power generation as a part of the programme of the Bureau of Reclamation since its inception to the present day is discussed. In the earlier days of the Bureau's work, power generation was merely to provide power during construction for construction operations. Later on power generation was undertaken to provide energy for pumps used in irrigation and drainage. In the latest projects typified by Boulder Dam power generation is deliberately included as a major consideration and is expected that the sale of power will contribute largely to the repayment of the cost of construction. Brief histories of power developments on various projects with summaries of their performances, rates, revenues, and obligations are given.

POWER GENERATION AT BOULDER DAM.

The initial installation of generating equipment at the Boulder Dam power plant has been completed. Four generators, each of 82,500 kilovolt-ampere capacity, largest in the world, have been installed, and placed in operation on the line serving the city of Los Angeles.

GROWTH OF LAKE MEAD.

Lake Mead formed by Boulder Dam is now 98 miles long and covers 67,500 acres. The storage has reached 10,000,000 acre ft. which is approximately one third the full capacity of the reservoir.

TOWERS USED ON TOPOGRAPHIC SURVEY OF THE MARSHALL FORD RESERVOIR SITE, COLORADO RIVER PROJECT, TEXAS.

Plane table topogaphy to a scale of 500 ft. to an inch with 10 ft. contour intervals was decided upon for the site of the Marshall Ford Reservoir. The work however was hampered in heavily timbered localities and a portable tower for the topographer to work upon was built and put in use. It is 22 ft. 6 inches high with a base 2 ft. 6 in. square and a 5 ft. square working platform.

SOIL SCIENCE.

Vol. 42.

No. 1—July 1936.

Reclamation of Alkali Soils by Electro-dialysis. Puri. Anand.

Alkali soils owe their characteristic features to the presence of exchangeable sodium. When an electric current is passed through the soil, the soil particles being negatively charged move towards the anode and the exchangeable bases towards the cathode. To investigate the possibilities of using this method on a field scale to reclaim alkali land by the separation of sodium, some laboratory experiments and field trials were carried out at the Punjab Irrigation Research Institute. These experiments and trials are described in this article and results are discussed. The investigations show that it is possible to remove sodium from alkali soils on a field scale by this method.

WATER WORKS & SEWERAGE.

Vol. 83.

No. 5—May 1936.

Water: A Discussion of Flows, Friction Measurement and Power.

This article furnishes information and data on the design of pipe lines, and measuring devices such as venturi meters and pipe orifices. A general discussion of the flow of water through pipes, open channels, orifices etc. is given, and the formulæ in use are stated. These include the Chezy formula, and the Hazen-Williams formula. A table of coefficients to be used in the Hazen-Williams formula is given. Tables of loss of head in pipes calculated from the same formula are given, and the measurement of flowing water is also dealt with. A table is given showing horsepower for 1 cubic ft. of water per second under heads of 1 to 2,000 ft. based on an efficiency of 80 per cent.

Practical Hydraulics. Wilson.

This article deals with the sharp crested weir as a device for the measurement of flowing water in open channels or streams. One of the most commonly used formulæ for rectangular sharp crested weirs known as the Francis formula is given and a table of discharges based on this formula is included in the article.

Pipe Line Friction Coefficients.

A summary of the findings of the Committee on Pipe Line Friction Coefficients.

WATER WORKS ENGINEERING.

Vol. 89.

No. 18—September 2, 1936.

Transforming Surface Water into Underground Storage. Lane.

Water spreading is the artificial application of water upon the ground surface in such a manner as to allow the water to sink into and become part of the underground water. By spreading water over pervious areas ground water is augmented and water otherwise wasted is stored for future use. This article discusses economical and legal aspects of water spreading, lays down principles to be observed in the selection of spreading areas and describes the methods generally used in Southern California for spreading water. These methods are the ditch or furrow method, the basin method and the well or shaft method. Conditions under which the different methods are used are given. Spreading by wells and shafts is expensive. The basin method has been found to be the most suitable to meet all conditions.

THE AGRICULTURAL JOURNAL OF BRITISH GUIANA.

Vol. VII.

No. 2—June 1936.

Padi Cultivation in British Guiana. Burnett.

The present methods and conditions under which paddy cultivation is carried out in British Guiana are reviewed in this article.

Fertiliser Investigations with Padi. Follett-Smith.

Describes results of manurial experiments with paddy conducted at the Botanic gardens, Georgetown.

THE AUSTRALIAN SURVEYOR.

Vol. 5.

No. 8—December 1, 1935.

Surveying in connection with Modern Dam Construction. Cohen.

Survey methods adopted in the construction of the Wellington Dam in Australia are described in this article. The dam is a concrete gravity dam 750 ft. long, consisting of 2 straight wings joined by a curved section of 300 ft. radius. The height from foundation level is 64 ft. The upstream face is vertical and the downstream slope has a slope of 1 : 2 upto 35 ft. from the foundation level, from which point it is curved to the crest. Expansion joints were provided at every 50 ft. horizontal distance. The survey included a traverse of the top water level, determination of the most economical site for the dam, location of expansion joints, and layout. Some details of actual construction of the dam are also given.

BAROMETRIC LEVELLING. Miller.

The use of the aneroid barometer for levelling purposes is dealt with in this article. The formula used for reducing the barometric heights from observations is explained. The shortcomings of the aneroid barometer for levelling are discussed and the field procedure is outlined

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JOURNAL OF THE COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH, AUSTRALIA.

VOL. 10.

No. 2—May 1937.

No articles of interest to irrigation engineers.

JOURNAL OF THE INSTITUTION OF ENGINEERS, AUSTRALIA.

VOL. 9.

No. 2—February 1937.

MODEL ANALYSIS OF AN ARCH SPAN OF 344 FEET. Bull.

This paper describes a model investigation of the stresses in the main 344 ft. arch span of the bridge over Long Bay. The analysis was made by means of a special deformeter apparatus which is specially suitable for this type of work and gives accurate results. The apparatus is described. The construction of the model and methods of analysis are described and the common errors are discussed. An analysis of temperature stresses is also included.

No. 3—March 1937.

No. 4—April 1937.

There is nothing of interest to irrigation engineers in these issues.

No. 5—May 1937.

ELECTRIC WELDING OF STEEL BRIDGES. Karmalsky. Linton.

This paper describes some bridge works carried out with electric arc welding and gives a comparison of weights of steel work in welded, riveted, and shop welded, field riveted structures. Design, fabrication and erection in the field are discussed.

DISCUSSIONS & COMMUNICATIONS.

THE DESIGN AND CONSTRUCTION OF COMPOSITE SLAB AND GIRDER BRIDGES. Knight.

Mr. Bridgland contributes a written discussion on the above paper which was published in January 1934 issue of the Journal. He gives an analysis of shrinkage stresses in a composite slab and girder, and considers the factor of creep in the concrete affecting stresses. He suggests the use of an effective modulus of elasticity according to the amount of creep. He considers that in the design of composite sections, shrinkage and creep are both factors which are to be taken account of.

PUBLICATIONS OF VARIOUS GOVTS., INSTITUTIONS SOCIETIES, ETC.

INDIA.

Central Government.

AGRICULTURAL STATISTICS OF INDIA, 1933-34, VOLS. I. II.

This is an annual report in two volumes published by the Department of Commercial Intelligence and Statistics, Government of India. Vol. I gives figures of area, classification of area, area under irrigation, area under crops, live-stock, land revenue assessment and harvest prices in British India, while Vol. II gives similar data for Indian States.

AGRICULTURAL STATISTICS OF INDIA, 1934-35, VOL. I.

See notes above.

CONTROL OF MALARIA IN DELHI : REPORT OF THE ANTI-MALARIA COMMITTEE, 1936.

The proposal to cut off the Western Jumna Canal some distance above Delhi and fill in its bed was considered. The importance of closing the canal in this way was stressed by the Committee but they were of opinion that considerable administrative difficulties are likely to arise if these schemes are carried into effect.

The report contains separate notes by the Director, Malaria Survey, Consulting Engineer, Malaria Survey, the Superintending Engineer, Western Jumna Canal Circle, and the special sub-committee of engineers.

SCIENTIFIC REPORTS OF THE IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, NEW DELHI, FOR YEAR ENDING JUNE 30, 1936.

The research work includes large scale experiments on the economical methods of green manuring with sann hemp, yield trials of some types of wheat, sugarcane breeding work in Coimbatore, insect pest investigations, and sugarcane mosaic investigations.

Programme of future work is given and includes work on the breeding of wheat, barley, oats and maize, study of soils for their physical, chemical, and micro-biological properties, survey of plant diseases and work on sugarcane breeding at Coimbatore and Karnal. Reports of the Imperial Agriculturist, Imperial Economic Botanist, the sugarcane expert, the Imperial Agricultural Chemist and the Imperial Mycologist are embodied in this publication. The report of the Imperial Agriculturist gives details of experiments with river silt for manuring sugarcane at Pusa. Chemical composition of the silt is given. Though the results of similar experiments during the two previous years indicated a better prospect for silt, the same was not maintained in the present year.

RULES OF THE LIBRARY OF THE IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, NEW DELHI.

I.—NOTE ON THE RESULTS OF AFFORESTATION OF JAMNA, CHAMBAL AND OTHER RAVINES. Sah.

II.—NOTE ON SOIL EROSION IN THE PUNJAB. Gorrie.

I—There are extensive waste and ravine lands along the Jumna and Chambal rivers in the United Provinces. A scheme of afforestation of the ravines along these rivers was started in 1912 and continued for 15 years. During this period 16,650 acres of ravine land were planted with timber and fuel species. The results of the operation of the scheme are discussed and it is concluded that ravine management and prevention of erosion are questions of control of grazing and improvement and preservation of grasses. It is the grasses that matter and not trees as a preventive of surface run off and erosion. It is usually mere waste of money to introduce timber or fuel species with the hope of m king an afforestation scheme pay. Indigenous fuel species can be improved and their natural regeneration can be encouraged at very little cost. Small earth dams at the heads of ravines are useful in preventing soil erosion.

II.—The second note deals with erosion conditions in the Punjab. (See bulletin No. 5, page 154).

RULES ISSUED BY SURVEY OF INDIA DEPARTMENT REGARDING THE EXECUTION OF LITHOGRAPHIC OR PHOTOGRAPHIC WORK.

REPORT OF THE SCIENTIFIC ADVISORY BOARD FOR THE YEAR 1ST JANUARY TO 31ST DECEMBER 1936 (Issued by the Indian Research Fund Association).

The report deals with medical and nutrition researches carried out during the year. The Malaria Advisory Committee passed a resolution as follows :—

"Since a large amount of Malaria is produced in India by the execution of engineering projects, this Committee recommends that all engineers should be required to undergo a short course of training in the elements of tropical sanitation before taking up appointments in Government service".

Institution of Engineers (India).

JOURNAL OF THE INSTITUTION OF ENGINEERS (INDIA) INCLUDING THE TRANSACTIONS OF LOCAL CENTRES, VOL. XV, JULY 1935.

OPEN-END TYPE TUBE WELLS. Trivedi.

It is well known that yield of water from ordinary wells is very limited. If the well rests on 'mota' or a thick bed of clay and if this bed is pierced through and the water bearing stratum below is tapped, considerably larger quantities of water can be obtained. What actually happens is that when the clay bed is pierced, and water is pumped out, a good deal of sand rushes with the water into the well. This sand has to be removed and more sand drawn into the well till a sufficiently large cavity with clear water is formed below the clay bed.

The conditions governing this process and the limitations of this type of well were not known. With a view to ascertain these, two experimental wells were sunk, one at Unao and the other at Hathras in the United Provinces. The experimental wells were successful and were the foundations of the water-works in these places. In this article the author gives a brief description of the experimental wells together with the nature of the strata and the observations made and the conclusions arrived at.

TEMPERATURE STRESSES IN REINFORCED BRICK WORK AND THE FAILURE OF REINFORCED BRICKWORK ROOFS.

Raja Ram.
Anand Saroop.

Describes experiments carried out in the Physics Laboratory of the Thomason Civil Engineering College, Roorkee in 1932 with a view to determine the coefficient of expansion of steel, 1 :3 cement and sand mortar, and specially selected 1st class brick. Hitherto it was the practice to ignore temperature in the design of reinforced brickwork, as the stresses in ordinary work are generally insignificant. As cracks have appeared several years after their construction in the reinforced brick roof slabs of buildings in Patna, Benares University and New Delhi, it was decided to investigate the causes. One of the obvious causes of failure of reinforced brickwork may lie in the difference between the coefficients of expansion of steel, brick, and cement mortar. The experiments described were undertaken to determine the coefficients for the materials named above. From the results of the experiments it is concluded in most cases the failure of reinforced brickwork can be traced to temperature stresses and difference in coefficients of expansion of the materials used.

THE ECONOMIC DIMENSIONS OF REINFORCED CONCRETE RESERVOIRS.

Williams.

In this paper a method is described of arriving at the most economical dimensions of two types of open reinforced concrete reservoirs type A, those in which the thrust produced by the water pressure is resisted entirely by the tension in the horizontal reinforcements of the wall, and type B, reservoirs with walls built as retaining walls. Only uncovered types of reservoirs are dealt with.

THE POSSIBILITY OF FLOOD REGULATION AND CONSERVATION IN THE HIMALAYAS FOR IRRIGATION OR POWER.

Meares.

This paper puts forward a proposal of building storage reservoirs in the Himalayan rivers by means of hydraulic fill or blasted earthen dams of great length and height, with byepass tunnels of sufficient capacity to prevent any possibility of a dam being topped and destroyed by flood. The desirability of storage in the Himalayas has long been recognized but it was not considered an economic proposition. Recently the Severn Barrage Committee have made a proposal of closing the tidal shoots (deep and rapidly flowing channels) by dam consisting of two banks 500 to 1000 ft.

apart across the shoots with a filling of sand in the intervening space. This type of construction is suggested for the Himalayas along with bye-pass tunnels for diversion of the streams during floods. A procedure of construction is suggested. Such a dam according to the author would be unaffected by earthquakes.

PRACTICAL NOTES IN CONNECTION WITH THE CONSTRUCTION OF A REINFORCED CONCRETE SUBMERSIBLE BRIDGE OVER THE RIVER NERBUDDA NEAR JUBBULPORE. — Walton. Gupta.

The main features of design and construction of a reinforced concrete bridge which would be submerged during floods is described in this article. The reasons for selecting this type of bridge are :

(1) The difference between the highest and lowest flood level is nearly 78 ft. During the flood season the river is a quarter of a mile wide and the maximum velocity is 15 ft. per second. In the dry season the river shrinks to a small channel 100 ft. wide and 2 or 3 ft. deep.

(2) During high floods big trees complete with roots and branches are carried down the river.

The adoption of the submergible type was a distinct economic advantage. The piers are of stone masonry with open foundations. The superstructure consists of reinforced concrete arches with spans from 50 ft. to 105 ft. Three piers were erected on precast concrete pile foundations. The construction operations are briefly described.

MEMORANDUM, CONSTITUTION AND BY-LAWS OF THE MECHANICAL ENGINEERS' ASSOCIATION (INDIA).

BIHAR AND ORISSA.

Public Works Department.

MANUAL FOR THE USE OF THE IRRIGATION BRANCH OF THE PUBLIC WORKS DEPARTMENT OF THE BIHAR & ORISSA GOVERNMENT.

Contains rules regarding maintenance of embankments, procedure of dealing with irrigation and drainage schemes, rules and regulation regarding navigation rules for irrigation powers of Superintending and Executive Engineers, rules of land acquisition and procedure of leave, appointment, dismissal and punishment of officials.

CENTRAL PROVINCES.

Public Works Department.

EXTRACT FROM THE COMPLETION REPORT OF BORINA TANK PROJECT IN THE JUBBULPORE DISTRICT.

The stage I estimate amounted to Rs. 4,00,000 for works only and Rs. 4,98,000 including charges, and provided for a dam of the arched buttress type of a maximum height of 97·5 feet with a storage capacity of 157 m. cft. to command an area of 12,000 acres. After the construction began it was found that the foundation rock, which appeared to be sound at the time of survey, was much shattered and fissured. Thus it became doubtful if the reservoir could be made watertight. After careful examination it was decided to reduce the height of the dam by 25 feet, maintaining the same section as originally designed, and to construct a subsidiary earthen dam three-fourths of a mile downstream of the main dam and having a capacity of 18 m. cft. The idea in constructing the subsidiary weir was that it would hold the water leaking from the upper tank but the leakage from this dam is nearly as great as from the upper one. Gives also the description of sluices, waste weirs, etc., of the dams. A longitudinal section of the Borina dam is also attached.

PUNJAB.

Irrigation Department.

Punjab Irrigation Branch Technical Notes.

NOTE, DATED 10TH SEPTEMBER 1922, ON THE GIBB TAIL OUTLET. (Class B, No. 1.). Lindley.

This type of outlet is the first devised to distribute supply at the tails of channels independently of the differing and varying working heads of water courses. This type was also adopted in remodelling schemes of the Lower Chenab Canal. The note gives the results of tests undertaken to calibrate it accurately.

REPRINT OF NOTES ON (1) MATERIALS AND RATES, AND (2) EARTHWORK RATES, FOR THE UPPER JHELUM CANAL, 1925. (Class B, No. 2.). Farrant.

Notes on the manufacture of bricks, surkhi, ballast, lime, kankar lime, with analiysis of rates. Specifications of finished materials and schedules of rates are also given.

NOTE, DATED 28TH JUNE 1922, ON THE USE OF PLAIN PIPES AS SEMI-MODULES. (Class B, No. 3.) Lindley.

In this note the author has shown that discharge of a plain pipe is semi-modular as long as delivery level is slightly below the soffit at the delivery end. The calculations of head or depression necessary to give a designed discharge are explained. The author has used this method of calculation in using pipes extensively as semi-modules in the Jhang Branch of the Lower Chenab Canal.

REPORT, DATED 1ST MAY 1922, ON EXPERIMENTS CARRIED OUT ON THE WALTON RISING SILL GATE. (Class B, No. 4.). Burkitt.
Robertson.
Gunn.

This is a report on experiments carried out with the Walton Rising Sill Gate in the Punjab by the authors. The method of conducting the experiments with various forms of this gate are described. and results are plotted graphically.

NOTES ON THE RESULT OF TEST CARRIED OUT ON SANDS FROM THE SUTLEJ RIVER AND PUNJAB PORTLAND CEMENT. (Class B. No. 7.) 1923. Robertson.

It was decided by a sub-committee consisting of some Punjab Engineers and two representives of the Punjab Portland Cement Company to undertake a series of tests with Sutlej sand and Punjab Portland Cement. The tests are detailed below :—

1. Tests of fineness, percentage of void and suitable grading of sand.
2. Testing ballast for voids.
3. Dry materials required per hundred cubic feet of completed concrete with mixtures in the proportion of 1 cement and 3 sand to 1 cement and 8 sand
4. Breaking tests, compression and tension.

The results of the tests are presented in this report.

SOLUTION OF QUADRITIC AND CUBIC EQUATIONS BY THE SLIDE-RULE. (Class B, No. 8.) 1924. Lindley.

CONTRACTED VEINS. (Class B, No. 9) 1926. Routh.

In this note are discussed the practical applications of the contracted vein principles in canal work. Examples of the use of this principle are to be found in venturi flume outlets. Other uses advocated are :—

(1) Portable contracted vein with curved approach and exit to measure discharge of water-courses.

(2) Permanent masonry contracted veins to measure discharges of minors and moderate sized distributaries.

(3) Contracted flume heads for distributaries.

(4) Flumed bridges and syphons.

The special advantages obtained with a flume design in each of the above cases are discussed.

NOTE ON PROBABLE FULL SUPPLY FACTOR FOR RICE IN SINDH. (Class B, No. 10), 1925. Chopra.

Dr. Summers, at one time Chief Engineer in Sind, criticized adversely the duties and full supply factors adopted for the Sukkur Barrage Canals. The views of Dr. Summers with regard to the length of the rice season in Sind, total depth of water in the field required for rice, and the duty, are criticized in this note and the author, has quoted his own experiments on the Upper Chenab Canal and elsewhere. He has given information about the amount of water needed for rice in different parts of the world. Conditions in Sind are analogous to those in the Lower Bari Doab Canal and it may be well expected that soon after the Barrage Canals are in operation, reasonable rice duties will prevail in Sind.

NOTE, DATED 15TH SEPTEMBER 1925, ON DAMAGE TO CHHATTA SYPHON AND THE METHOD ADOPTED TO REPAIR IT. (Class B, No. 13). Uppal.

This Syphon is built on the Lower Chenab Canal. During a canal closure, water got into the canal bed from the syphon below, through which a flood was passing. Two lines of cracks were discovered extending through the arches of the syphon and the concrete bed of the canal. The method of repairing the damage is described.

REPORT ON A TOUR IN CANADA AND THE UNITED STATES OF AMERICA. (Class D, No. 1.) 1922. Robertson.

The tour was arranged in order to obtain ideas which might assist in the construction of works which were being undertaken in the Punjab at the time. The works inspected include earthwork, concrete, masonry works, caissons, etc. A list of the works inspected is given. Special features are described and many illustrations are attached.

Note on Shannon Power Scheme. (Class D, No. 2.), 1928. — Robertson.

The Shannon Power Scheme is a very large hydro-electric project in the Irish Free State. The Shannon is the largest river in Ireland. The scheme comprises a weir across the river at which the head race of the power channel takes off on the right bank. There is a fall of 100 feet from the head race to the tail race. Design of the power schemes and construction operations are briefly described.

History of the Jaba level crossing, Upper Jhelum Canal. (Class E, No. 3), 1927.

The Jaba Nadi crosses the alignment of the Upper Jhelum Canal, the natural bed of the torrent being one mile in width. Floods coming down the Nadi are passed across the Canal through the Jaba level crossing of which the Jaba weir forms the escape portion. The work was completed in 1912 but repeated damages occurred owing to high floods and repairs had to be undertaken in 1912, 1916, 1919, and 1921. Extensive repairs were undertaken in May 1926. Several Plates showing the various repairs undertaken are appended.

History of the capacity of the Upper Chenab Canal. (Class E, No. 6.), 1930.

The area proposed to be irrigated and the discharge of the canal have been revised since the original project. This publication gives details of the orders sanctioning the revision, and the revised areas and discharges.

History of 1929 high floods in Indus, Jhelum and Chenab rivers. (Class E, No. 7.), 1931.

Hydrographs of the various gauge sites on the three rivers are given and discharge curves where discharge figures were available. The flood of 1929 was abnormally high.

Series of lectures on irrigation delivered in April 1931 to the rural economy class at the Agricultural College, Lyallpur. (Class B, No. 8) 1932. — Chopra.

These lectures describe the development and progress of irrigation in the Punjab and discuss the effects of irrigation on the life and conditions in the Province. Management of canals, points of contact with cultivator, and field distribution are also dealt with.

HISTORY OF THE CAPACITY OF THE LOWER BARI DOAB CANAL. (Class E, No. 11. 1934.

Gives a history of the revision of the discharges and proposed areas on the canal. and the revised figures for discharge, etc.

HISTORY OF BALLOKI, HEADWORKS, LOWER BARI DOAB CANAL, FOR 1935-36.

Works constructed, damaged and repaired are described. As a result of observation of the high residual pressures under the downstream floor, a model of the weir was tested in the Irrigation Research Institute at Lahore. It was concluded that the whole of the foundations below Bay No. 30 were degenerating. The question of strengthening the downstream floor was considered, but it was decided to construct, in Bays 1 to 25, a subsidiary weir immediately above the last line of wells. A suitable section was determined in the laboratory at Lahore.

Punjab Canal Gazetteers.

LOWER JHELUM CANAL, 1920. (VOL. I.).

Gives history of the project, description of the area commanded. descriptions of the canal and works, maintenance and repairs of canal works, control and distribution of water. and details of capital cost, etc.

TRIPLE CANALS (Upper Jhelum, Upper Chenab and Lower Bari Doab Canals). (Vol. II.).

Gives history of the project, description of commanded area., details of water regulation and distributaries. etc.

Publications of the Irrigation Research Institute.

THE GENERAL THEORY OF THE GRADIENT OF PRESSURE UNDER A STRUCTURE ON PERMEABLE FOUNDATIONS, WITH APPLICATIONS TO THE EVALUATION OF THE GRADIENT AT EXIT FOR SOME STANDARD CASES. (Research Publication, Vol. II, No. 16, October 1935). — Malhotra. McKenzie-Taylor.

The theory of the gradient of pressure is developed from first principles and its bearing on the velocity of flow at the angles of the structures indicated. The expressions for gradient at any point in the medium of flow are obtained and the values of exit gradient for the toe determined for a number of standard forms.

THE SOILS OF THE RICE AREAS OF THE GUJRANWALA AND SHEIKHUPURA DIVISIONS OF THE UPPER CHENAB CANAL. (Research Publication, Vol. III, No. 2, 1937.) **Mehta.**

A soil survey of the areas was undertaken with a view to determine the soil characteristics of the areas which have been continually under rice and to obtain information on the soil deterioration that has taken place. In all 238 samples were obtained and the results of the examination are given. Conclusions arrived at are set forth.

A STUDY OF THE SOIL PROFILES OF THE PUNJAB PLAINS WITH REFERENCE TO THEIR NATURAL FLORA. (Research Publication, Vol. III, No. 3, August 1936.). **Hoon.** **Mehta.**

In the course of the soil survey of the Haveli Project, it was noticed that areas occurred in which certain types of natural flora appeared to be dominant. It was decided to examine the soils on which these dominant types of vegetation occur in more detail. The experimental work done is described and results are discussed.

Agricultural Department.

REPORT ON THE OPERATIONS OF THE DEPARTMENT OF AGRICULTURE, PUNJAB, FOR THE YEAR ENDING 30TH JUNE 1936

Agricultural research included irrigation experiments on cotton which showed that heavier irrigation increases the yield, and first irrigation should be given 3 to 4 weeks after sowing, no irrigation being necessary after the 15th October. Rice investigations include stages of transplanting, and effect of late planting. Mycological researches include investigations on sugarcane, wheat and fruit diseases. Experiments on reclamation of kallar soils by applying calcium are in progress. The activities of the Agricultural Engineering section were confined largely to well boring operations some of which are described. Programme of research work for the ensuing year is given.

PUNJAB AGRICULTURAL DEPARTMENT SEASONAL NOTES, VOL. XV, NO. 1, APRIL 1937.

Contains short notes on agricultural matters which are useful to the cultivator. The following may be mentioned :—

1. Suggestion for maintaining and increasing the marketable value of Punjab wheat.
2. Trials with autumn planted sugarcane at the Agricultural Station, Gurdaspur.

3. Optimum time for sowing irrigated cotton in the Punjab.
4. Uses of Soyabean.
5. Where forestry helps the zamindars.

List of leaflets issued by the Punjab Agricultural Department is given. Seed agencies in the Punjab are mentioned. Improved agricultural machines are described.

BOMBAY.

Public Works Department.

GOVERNMENT OF BOMBAY, P. W. D., RESOLUTION No. 4042/27. DATED 2ND SEPTEMBER 1931.

Orders regarding the classification of crops on the major irrigation works in the Deccan Irrigation Circle, and the Irrigation Development and Research Circle. In the old classification the crops were divided into two classes, heavy and light. In the new classification, the crops have been divided into three classes, heavy, medium and light.

GOVERNMENT OF BOMBAY, P. W. D., RESOLUTION No. 5602/27, DATED 23RD SEPTEMBER 1933.

Orders regarding the water rates for irrigational and non-irrigational purposes on all the major and minor irrigation works in the Deccan Irrigation Circle.

GOVERNMENT OF BOMBAY, P. W. D., RESOLUTION No. 5602/27, DATED 3RD JANUARY 1935.

Orders regarding certain concessions in the water rates for irrigational purposes on the Nira Right Bank Canal.

GOVERNMENT OF BOMBAY, P. W. D., RESOLUTION No. 5602/27, DATED 3RD DECEMBER 1935.

Orders regarding the water rates for irrigational and non-irrigational purposes on all major and minor irrigation works in the Deccan Irrigation Circle.

GOVERNMENT OF BOMBAY, P. W. D., RESOLUTION No. 346/36, DATED 19TH MAY 1936.

Orders regarding the classification of crops of Soyabean and African Bajri.

GOVERNMENT OF BOMBAY, P. W. D., RESOLUTION No. 5602/27, DATED 29TH AUGUST 1936.

Orders regarding withdrawal of the concession of half rates in the case of long term fruit trees on the Nira Right Bank Canal.

Annual note on hydrodynamic, soil and effluent research carried out at the experiment station at Lake Fife near Poona, during 1935-36.

Summary of the Report has already been given on page 4 of Bulletin No. 3.

Agricultural Department.

Annual report of the Department of Agriculture in the Bombay Presidency, 1935-36.

Agricultural research work included research on soil erosion at Poona, experiments on manuring rice with sulphate of ammonia, breeding and manurial experiments with cotton and wheat, maintenance of soil fertility with farmyard manure, compost and bone manure, and plant diseases and pest investigations. Nitrogen fixation in rice fields is also being investigated.

SIND.

Public Works Department.

Manual of irrigation for canal assistants and abdars in Sind.

Hints to engineers in charge of irrigation in Sind, 1931.

Instructions for guidance of officers in matters dealing with bunds, maintenance of canals, regulators and bridges, bungalows and gardens, etc.

General instructions for the opening of new canals in Sind, 1931.

Contains instructions for guidance of officers when the new Lloyd Barrage canals were opened.

Indus River Commission Records, 16th October 1933 to 15th October 1934, Volume I.

Contains Reports and Statements grouped in Parts I to III containing Gauge Readings, Discharges, Velocities and Silt Charges of the River Indus, Daily Withdrawals of Sind Canals, Rainfall Statements, various other Miscellaneous Observations, a descriptive note and important correspondence.

INDUS RIVER COMMISSION RECORDS, 1933-34, VOLUME II, PART II.

Contains drawings in connection with Statements in Volume I.

INDUS RIVER COMMISSION RECORDS, 16TH OCTOBER 1934, TO 15TH OCTOBER 1935, VOLUME I.

Contains Reports and Statements grouped in Parts I to III containing Gauge Readings, Discharges, Velocities and Silt Charges of the River Indus, Daily Withdrawals of Sind Canals, Rainfall Statements, various other Miscellaneous Observations, a descriptive note and important correspondence.

INDUS RIVER COMMISSION RECORDS, 1934-35, VOLUME II, PART II.

Contains drawings in connection with Statements in Volume I.

STATEMENT OF FINAL AREA OF KHARIF CULTIVATION FOR THE YEAR 1936 IN SIND.

The note accompanying the statement says that the cultivation has been very good being 105·3 per cent. of that forecasted. The total area under rice was 5·45 lakhs acres and under cotton 9·25 lakhs acres. The total area of kharif cultivation was 18·40 lakhs acres.

WEEKLY STATEMENTS SHOWING KHARIF CULTIVATION AREAS UP TO 26TH JUNE 1937 IN SIND AS COMPARED WITH THOSE OBTAINED UP TO THE CORRESPONDING DATE LAST YEAR.

Agricultural Department.

THE IRRIGATION OF DRY CROPS IN THE BARRAGE AREAS INCLUDING A SUGGESTED TIME-TABLE OF AGRICULTURAL OPERATIONS AND DISTRIBUTION OF IRRIGATION WATER. Sind Agricultural Department, Leaflet No. 35 (1st edition, March 1934).

Discusses irrigation requirements of kharif and rabi crops in Sind, rotation of crops, importance of including green manure crops in a rotation and the advantages of timely sowing of crops. A tentative programme of agricultural operations is given.

IRRIGATION AND CULTIVATION OF THE RICE CROP IN THE BARRAGE AREAS OF SIND. Sind Agricultural Department Leaflet No. 43 (1st edition, November 1934).

Contains important facts and considerations in connection with the irrigation of rice crop under Barrage water supply. Irrigation requirements of the rice crop are explained and a programme of irrigation operations for rice is given.

A PRACTICAL METHOD OF UTILISING IRRIGATION WATER DURING OCTOBER FOR GROWING WHEAT CROP IN BARRAGE AREAS. Sind Agricultural Department Leaflet No. 47 (1st edition, July 1935).

This leaflet describes in detail the methods, by the adoption of which, irrigation water in October can be fully utilized for growing wheat.

A NOTE ON THE IRRIGATION OF FIELD CROPS IN THE BARRAGE AND NON-BARRAGE AREAS OF SIND. Sind Agricultural Department Leaflet No. 50 (1st edition, March 1936).

The term cusec', 'duty' and 'delta' or 'depth of water' are defined and the duty in Barrage Canals is compared with that of short period inundation canals. The duty in the Barrage areas is higher than in non-Barrage areas. Practical methods of making full use of the irrigation over the whole period of its supply are suggested.

MADRAS.

Public Works Department.

IRRIGATION CIRCULAR MEMORANDUM No. 3075/36-C.E.P., DATED 21ST SEPTEMBER 1936. REGARDING THIPPAYAPALEM RESERVOIR BUND-BREACH.

The reservoir was formed by an earthen bund flanked by surplus weirs on either side. The bund was 312 ft. long and 55 ft. high with a masonry core wall in the centre. Within two months of its completion there was heavy rain in the catchment and the bund was breached at two places on the two flanks where it joined on to the masonry of the weirs. Examination showed that the bund was consolidated hard, but the material forming the bund was of an alkaline nature. Further experiments with experimental tanks made of this material proved the unsuitable nature of the material for an earthen bund. In this circular attention is drawn to the importance of testing a material for an earthen dam before construction. Two drawings of the work are appended.

Agricultural Department.

IRRIGATION. Department of Agriculture, Madras, Vol. IV, Bulletin No. 20. Wood.

Notes of a series of lectures on Agriculture delivered at the Coimbatore College. This is an old publication first published in 1917. Describes sources of irrigation water, the methods of lifting water as used in Madras Presidency, the duty of water, the use of irrigation water, methods of field irrigation, and drainage of surplus water from the fields. Open surface drains and mole drains are described. Alkalinity of soils and methods of reclamation are discussed.

WATER HYACINTH. Department of Agriculture, Madras, Leaflet No. 38, 1933.

The weed is described and its evil effects are mentioned. The eradication of this weed wherever it is found is strongly urged. This plant has been classed as a noxious weed under the Agricultural Pests and Diseases Act of Madras.

BALUCHISTAN.

Public Works Department.

IRRIGATION SUMMARY OF PUBLIC WORKS IN BALUCHISTAN FOR THE YEAR 1936-37.

The irrigation works enumerated are non-productive. The total area irrigated is about 21,000 acres. The areas of principal crops irrigated and the working expenses are given. The major work completed was the protective bund in the Nari River and a diversion cut in the same river. A few other works were also carried out by the Department from funds other than irrigation funds. These include the Spin Karez reservoir project, a drainage project for improving water-logging conditions in Quetta, and a few roads and buildings. Irrigation works in the Nasirabad Tahsil are carried out by the Sind Irrigation Department.

INDIAN STATES.

BRIEF NOTE ON IRRIGATION IN CAMBAY STATE.

Cambay State being the draining ground of vast catchments to the North and East, irrigation tanks have been formed wherever natural basins occur. The largest of the tanks is Kenewal Tank having an area of about 2 sq. miles and a capacity of 171 million cu. ft. of water and is capable of irrigating 3,400 acres of land by means of distributaries 8 miles long.

There is also a catchwater drain, called the Alang Channel, running across the country. It intercepts the monsoon flood diverting it into 8 tanks along its now extant length of 8 miles and finally discharging into the Cambay Creek and thus scouring it and keeping it open for navigation. This channel is stated to have been constructed in times gone by for diverting the waters of the Sabarmati river for irrigation.

COPY OF A LETTER NO. 226, DATED 2ND APRIL 1937 FROM THE DIWAN OF JANJIRA STATE, REGARDING RESERVOIRS AND DAMS IN THE JANJIRA STATE.

There are no irrigation dams in the State but there are small dams on perennial nalas for the supply of drinking water to towns and villages. The largest of them is 80 ft. in length, 16 ft. high, 8 ft. wide at the base and 6 ft. wide at the top.

LIST SHOWING THE DAMS IN THE MUDHOL STATE WITH APPROXIMATE AMOUNT SPENT FOR CONSTRUCTION.

MYSORE AGRICULTURAL CALENDAR 1937.

Published by the Department of Agriculture, Mysore State. Contains notes on the following subjects :—

1. Effect of manuring on the quality of crops.
2. Some weeds which are the scourge of paddy land in Mysore and methods of control.
3. Some diseases of apples.
4. Sugarcane borer control by cultural methods.
5. Method of controlling some underground insect pests of crops.

Instructions on agricultural operations to be carried out each month are given in the form of monthly notes.

BURMA.

Public Works Department.

COMPLETION REPORT AND SCHEDULES OF THE SALIN CANAL REMODELLING PROJECT.

A very old irrigation system in Salin, Upper Burma, consisting of a bund of earth and stakes across a river and a canal taking out therefrom was replaced by a new irrigation project. The project consisted of a masonry weir across the river and a new system of canals. The works are briefly described, the financial prospects are discussed and schedules of expenditure are given.

MANUAL OF DEPARTMENTAL INSTRUCTIONS FOR THE GUIDANCE OF OFFICERS OF THE IRRIGATION BRANCH, PUBLIC WORKS DEPARTMENT, BURMA.

Contains rules for the guidance of officers and subordinate staff in the Irrigation Branch and rules for working and maintenance of various irrigation works.

Association of Engineers in Burma.

PROCEEDINGS OF THE ASSOCIATION OF ENGINEERS IN BURMA, VOL. VIII, 1936.

MAP-MAKING IN BRITISH GUIANA. **Slater.**

A general account of surveying operations carried out in British Guiana in 1929.

EMERGENT REPAIR WORKS IN THE MEIKTILA IRRIGATION DIVISION. **Jackson.**

The exceptionally heavy rains of 1935 resulted in floods of unprecedented magnitude causing widespread damage to irrigation works and to roads and railways. The peak flood discharge was 1,30,000 cusecs for a catchment of 240 sq. miles giving a value of 2,140 for 'C' in Dicken's formula. This is almost a record for the Indian Empire. In the U. S. A. there are cases of flood discharges in which the value of 'C' works out to 3,380 and 4,550. This paper descibes the damage by floods to five irrigation works in the Meiktila Division and the repairs undertaken. Two of the works were reservoirs in which the earthen bunds breached and the escape weirs were damaged. The other three works are weirs. One of the weirs was so badly damaged that a new weir had to be built at a new site. In the two other weirs, the damages were confined to the divide walls, floor of the undersluices, and glacis of the weir. Model experiments were carried out at the

Ye-U Canal Division Hydraulic Laboratory to evolve the best form of divide wall, and to test the effect of a small concrete drop wall at the end of the glacis, followed by a horizontal floor having a dentated cill at its end. A most efficient arrangement of dentated cill was devised as the result of the investigations. Each of the five works is dealt with separately and detailed account of repairs carried out is given.

EGYPT.

REPORT ON THE NAG HAMMADI BARRAGE, 1927—1930. Naguib Bey Ibrahim. Ellison.

Gives details of design and construction of this barrage in Egypt. The chief features of the work were, use of sheet steel piling for the impervious floor, and piles for foundations cement grouting work in foundations and cableways for placing concrete. Some damage occurred to the permanent work during the 2nd year of construction by floods. The barrage has 100 bays of 6 metres each.

ASSIUT BARRAGE REMODELLING :

CEMENTATION OF CUT-OFFS AT VENTS NOS. 13, 39, 66 AND 93, NOVEMBER 1936.

The reasons for the provision of the cut-offs are described. Preliminary investigations to determine method of cementation are quoted (see page 131 of Bulletin No. 5). An emulsion consisting of bitumen and a patent chemical was used for cementation by means of injection pipes. The procedure of cementation is described. Tests were conducted to determine the effectiveness of the cementation. The cementation as carried out provided an efficient water-tight cut-off wall at the vents treated.

CANADA.

Department of Agriculture.

USE OF IRRIGATION WATER ON FARM CROPS. Dominion of Canada, Deptt. of Agriculture Publication 509, June 1936. Palmer.

"The experiments reported in this treatise were conducted at the Dominion Experimental station, Lethbridge and were planned :—

(1) To obtain information as to the stage of plant growth when water should be applied to field crops.

(2) To study the value of fall irrigation.

(3) To determine the number of irrigations required in different years by various crops.

(4) To investigate certain phases of the inter-relations of soils, soil moisture, and plant growth.

(5) To formulate standards of irrigation practice that will serve as a guide to farmers."

The experiments cover a period of from two to six years. A summary of conclusions based on the results of experiments is given at the end.

HYDRO-ELECTRIC PROGRESS IN CANADA IN 1936.

Describes hydro-electric progress in Canada in 1936. Very little addition was made to the total development of water power capacity but a number of developments are under construction. The total installation for the dominion at the end of the year amounts to 7,945,590 Horse Power. The principal activities during the year in the various provinces are described.

WATER POWER RESOURCES OF CANADA. No. 1933, March 1st, 1937.

This report presents a summarization of data and a brief discussion of the progress in the development and utilization of the water power resources of Canada. All existing stream flow and power data available have been systematically collated, analyzed and co-ordinated. The figures are based on rapids, falls, and power sites of which the actual head has been measured. The available water power is 20,347,400 H. P., and the total turbine installation is 7,945,590 H. P. Current year's progress in hydraulic plants is reviewed. Special reference is made to the contribution of water power to Canada's Central Electric Station, Mineral and Paper industries.

UNITED STATES OF AMERICA.

Department of Agriculture.

THE EFFECT OF CRAZY TOP DISORDER ON COTTON PLANTS AND ITS CONTROL BY IRRIGATION MANAGEMENT. Technical Bulletin No. 515, May 1936. — Hope. King. Parker.

SILTING OF RESERVOIRS. Technical Bulletin No. 524, July 1936. — Eakin.

The problem of silting of reservoirs is closely associated with problems of erosion control. The Soil Conservation Service of the U. S. A. instituted in 1934 an attempt at a general nation wide survey of the condition of reservoirs with respect to reduction of storage by silting. This publication is the progress report on reservoir surveys by the Soil Conservation Service in 1934-35. These studies were undertaken with the object of collecting information on the factors involved in the silting of reservoirs and rates of silting, and to correlate the results with soil, slope, climatic conditions and land use. The work so far accomplished by the Soil Conservation Service consists of detailed surveys of silt accumulation in representative reservoirs in South Eastern, South Central and South Western areas.

The report outlines the more important aspects of the problem such as economic and physical aspects. The process of silting of reservoirs is described, and previous investigations of the problem are detailed. The field work and methods of survey by the Soil Conservation Service are then outlined and each survey undertaken and completed by the service is described in detail. The general conclusions drawn are that reservoir silting is widely prevalent and the chief contributory cause is erosion. Control of erosion and silt production is the only reliable method of preventing depletion of reservoir storage by silting. The book contains many maps and illustrations.

THE CHOICE OF CROPS FOR SALINE LAND. Circular No. 404, July 1936.
Kearney.
Scofield.

This circular describes the constituents of the salts occurring in saline soils, the source of the salts and the effect of the salt constituent of soils on plant. It indicates cultural and irrigation methods to be adopted in dealing with saline soils, and names the plants which are most likely to succeed in them. Considerations governing choice of crops for saline lands are discussed. Some of the crop plants grown in the Western States are discussed in relation to their behaviour on saline soils.

Department of the Interior, Bureau of Reclamation.

TWENTY-FIRST ANNUAL REPORT OF THE RECLAMATION SERVICE, 1921-1922.

The report contains summary of construction results, summary of drainage works executed, details of power plants operated, and statements of financial details of the reclamation projects. The results of operations of projects completed by the Bureau of Reclamation are set forth and discussed. A description of project investigations carried out is given.

TWENTY-FIFTH ANNUAL REPORT OF THE BUREAU OF RECLAMATION FOR THE FISCAL YEAR ENDED JUNE 30, 1926.

TWENTY-EIGHTH ANNUAL REPORT OF THE COMMISSIONER OF RECLAMATION FOR THE FISCAL YEAR ENDED JUNE 30, 1929.

ANNUAL REPORT OF THE SECRETARY OF THE INTERIOR FOR THE FISCAL YEAR ENDED JUNE 30, 1933.

Contains detailed reports of the various Bureaux, divisions, and offices of the Department of the Interior. The report of the Bureau of Reclamation gives the progress of the various projects under construction during the year, and discusses economic and engineering operations on other projects which are completed or partially completed. Investigations of prospective projects are also described.

ANNUAL REPORT OF THE SECRETARY OF THE INTERIOR FOR THE FISCAL YEAR ENDED JUNE 30, 1934.

The report of the Bureau of Reclamation describes construction activities on projects in progress. Economic and engineering operations on other projects are detailed.

The soil erosion service was established during the year to lay the foundation of a permanent national erosion control programme to meet the acute land crisis created by wasteful methods of land utilization. The first report of this service discusses the question of erosion control and sets forth the programme of work.

ANNUAL REPORT OF THE SECRETARY OF THE INTERIOR FOR THE FISCAL YEAR ENDED JUNE 30, 1935.

The report of the Bureau of Reclamation states that during the year the Bureau was engaged in the largest construction programme in its history. The Boulder Dam was completed during the year. Construction activities are described, and the working of the various projects with regard to agricultural returns and water supply etc. are given.

ANNUAL REPORT OF THE SECRETARY OF THE INTERIOR FOR THE FISCAL YEAR ENDED JUNE 30, 1936.

The report of the Bureau of Reclamation draws attention to the importance of the Bureau and the good work done. The report suggests that time has now come when serious consideration should be given to the control of floods of small streams. Construction activities of the Bureau are described and results of operations on some of the projects are set forth.

University of California, Agricultural Experiment Station.

I. IRRIGATION EXPERIMENTS WITH PEACHES IN CALIFORNIA.
Hendrickson.
Veihmeyer.

II. CANNING QUALITY OF IRRIGATED PEACHES. Bulletin No. 479, November 1929.
Nichols.

WATER REIUIREMENTS OF COTTON ON SANDY LOAM SOILS IN SOUTHERN SAN JOAQUIN VALLEY. Bulletin No. 537, August 1932.
Beckett.
Dunshee.

This bulletin presents the results of a five year study dealing principally with the irrigation requirements of cotton grown on the sandy loam soils and the effect of soil moisture deficiency on growth and yields.

IRRIGATION EXPERIMENTS WITH PRUNES. Bulletin No. 573, May 1934.
Hendrickson.
Veihmeyer.

MEASURING WATER FOR IRRIGATION. Bulletin No. 588, March 1935.
Christiansen.

This bulletin describes the more common methods and devices used in measuring water for irrigation in California. The devices most commonly used, particularly in the small streams with which the farmer is concerned are weirs, orifices including adjustable and fixed submerged orifices, miner's inch boxes, Parshall flumes, commercial irrigation meters, and volumetric measurements. The various devices and their uses are described in detail and discharge tables are given showing discharges for different heads and crest lengths of weirs, and different cross sectional areas of orifices. The use of the Parshall measuring flume is discussed in detail, and standard dimensions of flumes from 3 to 9 inches throat width, and 1 to 10 feet throat width are given. The venturi tube is also described and tables are given to assist in solving equations for flow through venturi tubes. A concise statement of the hydraulic principles on which the methods of flow measurement are based, giving the various formulae applicable, is also included.

SULFURIC ACID FOR CONTROL OF WEEDS. Bulletin No. 596, November 1935.
Ball.
French.

This bulletin describes experiments on the control of weeds by sulphuric acid spraying. The object of the experiments was to determine the percentage of the weeds destroyed and the yields. General conclusions are given regarding factors influencing the effectiveness of sulphuric acid as a weed spray, the effects of the treatment on the soil and the cereal plant, and wetting agents. The equipment for spraying developed in California is described.

RECLAMATION OF WHITE-ALKALI SOILS IN THE IMPERIAL VALLEY. Bulletin No. 601, July 1936. Thomas.

Although a large part of the soil of the Imperial Valley is highly productive several thousand acres within it contain toxic amounts of soluble salts. In certain areas the salts were present in the surface before irrigation was started in the valley, but much of the land which at the outset was free from salt accumulation, shows excessive amounts of salts after several years of irrigation. Irrigation and seepage water has saturated the subsoil and caused a rise in the ground water level. A survey of alkali conditions in the Imperial Valley shows high concentrations of white alkali. An alkali reclamation experiment has been carried out in a typical area where alkali has accumulated on account of poor drainage. The treatment consisted of applying gypsum, sulphur and manure to the soil, the use of a plant tolerant to alkali as a green manure, and leaching. The experiments show that it is possible to reclaim the soil by leaching alone without special treatment with gypsum or sulphur.

SOLAR ENERGY AND ITS USE FOR HEATING WATER IN CALIFORNIA. Bulletin No. 602, November 1936. Brooks.

In California, direct use of solar energy as heat is now being made by several thousand solar water heaters. A theoretical discussion of the nature and the availability of solar energy, and its absorption by different surfaces is given. The solar water heater is then described. Some forms of solar water heater systems and their construction are explained.

ALKALI SOILS. Circular No. 292, June 1925 (Reprinted March 1931). Hibbard.

The purpose of this circular is to present in brief the best available information on the subject of Alkali soils in respect to their origin, nature effects, examination, treatment, and cropping. The circular is in the form of a questionnaire with replies to clarify the various issues raised.

DRAINAGE ON THE FARM. Circular No. 304 (Reprinted December 1930). Weir.

This circular describes the principles and methods of drainage of wet lands in California. Almost every farm contains some land that could be improved and made to produce more or better crops by some type of drainage. The object of drainage is to remove free water existing in the soil in excess of that necessary for plants. Two types of drains are in use for farm drainage, namely the open drain and the tile drain. The author considers tile drains to be more efficient. Design and construction of open and tile drains and their maintenance are dealt with in detail.

IRRIGATION OF ORCHARDS BY CONTOUR FURROWS. Agricultural Extension Service Circular No. 16, April 1928 (Revised September 1932). Huberty. Brown.

Contour planting of orchards is a common practice in California. The method consists of planting trees along a grade contour. The water distribution system consists of a main pipe or flume placed at right angles to the contours. Water is delivered from this pipe line to the tree rows which are on graded contours by means of hydrants or other similar device. This bulletin describes the method of laying out a system of contour planting and the irrigation or orchards planted according to this method.

ESSENTIALS OF IRRIGATION AND CULTIVATION OF ORCHARDS. Agricultural Extension Service Circular No. 50, December 1930 (Revised September 1936). Veihmeyer. Hendrickson.

This circular briefly summarizes results of experiments on the irrigation and cultivation of deciduous orchards.

COMMERCIAL FERTILIZERS AND SOIL FERTILITY IN CALIFORNIA. Agricultural Extension Service Circular No. 57, October 1931 (Reprinted June 1933). Hibbard.

A commercial fertilizer is a material which supplies one or more of the three elements, nitrogen, phosphorus and potassium. This circular gives information about commercial fertilizers and their effect on soils. The functions of nitrogen, phosphorus and potassium in plant nutrition are described. The need of fertilizers, procedure of selection of a suitable fertilizer, and methods of applying fertilizers are mentioned. Names of commercial fertilizers commonly used and their prices are given.

THE CONTOUR CHECK METHOD OF ORCHARD IRRIGATION. Agricultural Extension Service Circular No. 73, March 1933. Brown.

Contour checks are irregular basins formed by small levees or ridges located on level contours. The usual interval in elevation between contours is 2·4 inches. The ends of the contour levees are joined at the boundary of the tract by an enclosing levee. The position of the contour levees or ridges are determined by an engineer's level. Conditions under which this method may be used, description of the method, advantages and disadvantages of the method and instructions for laying out and designing a system of contour checks are contained in this bulletin. A brief description is also included, by types, of ridging equipment and machinery.

University of Iowa.

THE FLOW OF WATER THROUGH CULVERTS. Studies in Engineering Bulletin No. 1, New Series No. 103, February 15, 1926. Yarnell. Nagler. Woodward.

This bulletin presents the results of 3,301 experiments on the flow of water through short conduits such as pipe and box culverts and sluice ways under levees. The object was to determine the quantity of water that will flow through culverts of different materials and sizes, under actual working conditions. Methods of making the tests are described and the experimental results are discussed. The conclusions drawn from the tests are set forth. Velocity distribution curves through pipe culverts are given and discharge formulae for culverts have been developed.

LABORATORY TESTS ON HYDRAULIC MODELS OF THE HASTINGS DAM. Studies in Engineering Bulletin No. 2, New Series No. 230, July 1, 1932. Nelson.

The Hastings Dam was constructed across the Mississippi at Hastings with the object of developing a deeper navigable waterway on the upper Mississippi. The Hastings dam project is the initial unit in a plan contemplating the provision of a series of slack water pools formed by perament low head dams across the river. The dams will be built upon unstable alluvial foundations. A model study was made of the behaviour of the Hastings Dam under simulated operating conditions with a view to study erosion effects below the dam, to suggest improvements in the design, to determine coefficients for the spillway section, and to determine the best scheme of operation. The study was also conducted with a view to apply them in the design of other dams of the project. The studies carried out are described in this bulletin. The general results obtained from the studies are set forth in the introductory part of the bulletin. The features of the project, and the hydrology of the watershed are described, and the theoretical principles governing the use of hydraulic models are discussed. The actual models used are then described and the problems studied are given in detail.

TESTS OF ANCHORAGES FOR REINFORCING BARS. Studies in Engineering Bulletin No. 3, New Series No. 257, August 15, 1933. Fosey.

Special anchorages for the ends of reinforcing bars are almost universally used in reinforced concrete construction. This bulletin reports results of tests carried out by the writer on various types of anchorages. The tests were conducted with the object of finding an anchorage giving the high-ultimate values of spirally reinforced hooks but without their tendency to excessive slip. The writer states in conclusion that the most satisfactory anchorage tested during the 4 years covering the investigation was a straight embedded plain round bar the surface of which had been roughened by rows of indentations made with a blunt cold chisel.

A SUMMARY OF HYDROLOGIC DATA RALSTON CREEK WATERSHED, 1924-1935. Studies in Engineering Bulletin No. 9, New Series No. 328, December 1936. — Mavis. Soucek.

This bulletin presents a detailed summary of data pertaining to rainfall, run-off and ground water levels of the Ralston creek watershed, a drainage area of three square miles outside Iowa city.

FLOW CHARACTERISTICS IN ELBOW DRAFT TUBES. Studies in Engineering Reprint No. 1, New Series No. 333, May 1, 1937. — Mockmore.

This is reprinted from the Proceedings of the American Society of Civil Engineers February 1937. See page 103 of Bulletin No. 5.

REPORT ON HYDRAULICS AND PNEUMATICS OF PLUMBING DRAINAGE SYSTEMS—I, Studies in Engineering Bulletin No. 10, New Series No. 334, May 15, 1937. — Dawson. Kalinske.

AN INVESTIGATION OF SOME HAND MOTIONS USED IN FACTORY WORK, Studies in Engineering Bulletin No. 6, New Series No. 301, June 15, 1935. — Barnes.

RADIATION INTENSITIES AND HEAT-TRANSFER IN BOILER FURNACES, Studies in Engineering Bulletin No. 8, New Series No. 323, July 1936. — Croft. Schmarje.

Kansas Agricultural Experiment Station.

SOIL MOISTURE AND WINTER WHEAT WITH SUGGESTIONS ON ABANDONMENT. Bulletin No. 273, January 1936. — Hallsted. Mathews.

In regions of low rainfall, the yield of wheat is more or less dependent on the moisture content of the soil at seeding time. A knowledge of the effect of moisture content at seeding on the yield is a valuable guide to the farmer in deciding whether the crop should be abandoned in the early stages to avoid harvesting at a loss. Studies on the effect of moisture content at seeding on yield were conducted at a number of places and the results are published in this bulletin. The results are discussed and conclusions given at the end.

Oklahoma Agricultural Experiment Station.

SCIENCE SERVING AGRICULTURE: REPORT OF THE DIRECTOR, AGRICULTURAL EXPERIMENT STATION FOR JUNE 1, 1934 TO JUNE 30, 1936. Blackwell.

Contains report on insect pest studies, horticultural investigations, soils and crops investigations, plant diseases, and other matters connected with agriculture and animal husbandry.

Panhandle Agricultural Experiment Station.

WATER SURVEY OF TEXAS COUNTY, OKLAHOMA. Bulletin No. 20, October 1930. Houghton.

This bulletin presents results of a well water survey of Texas County of Oklahoma. The object of the survey was to determine whether sheet water exists in the counties, its source and abundance, its chemical nature, purity, and possible uses for household and agriculture. The procedure was to take samples in each township of the county, to collect information about depth of water, and to analyse the chemical and physical properties of the water collected from the wells. The method of chemical analysis is dealt with in detail and the effect of the presence of chlorine, nitrogen, phosphorus, potassium etc. in water is discussed.

WATER SURVEY OF CIMARRON COUNTY, OKLAHOMA. Bulletin No. 38, May 1932. Houghton.

This bulletin presents results of a well water survey of Cimarron County of Oklahoma, on the same lines as the well water survey of Texas county.

RESULTS OF LEVEL TERRACING ON HEAVY SILT LOAM SOIL. Bulletin No. 53, March 1934. Finnell.

Results of experiments on level terracing on heavy silt loam soil in Oklahoma with a view to determine the actual gains in soil moisture supplies accruing from the retention of run-off by terraces are given in this bulletin. Grain yields from terraced plots of various widths and unterraced plots are compared. Soil moisture determinations were made in order to find out the actual increase in soil moisture due to terracing and it was found that the increase varied from 0 to 55·4 per cent. of the available moisture. The average increase in yield worked out to 32·6 per cent. of the average unterraced yield.

Utah Agricultural Experiment Station.

WATER TABLE VARIATIONS : CAUSES AND EFFECTS. Bulletin No. 144, May 1916. Ballantyne.

A study was made of the effect of rainfall and irrigation water on the soil in relation specially to its free water content at various seasons, on the Utah Experiment Farm. The soil of the farm is sandy, specially below the first foot. Seepage conditions appeared on the farm and it became necessary to investigate ground water conditions. Seven wells were bored at different points on the farm, and the depth to water in them was measured for a period extending over 4 years. The measurements were taken bi-weekly at first, and bi-monthly afterwards. Irrigation and precipitation were noted as they occurred. Graphs showing depths observed during 3 years for all the wells have been included and the causes of variation of depths are discussed. Effect of irrigations on the depths is discussed in detail. The effect of the variation in depths on vegetation is also considered. Remedies to rectify the seepage conditions are suggested. The economical use of irrigation water is very important in preventing these seepage conditions. Conclusions arrived at are :

1. The level of free underground water went down through the action of natural drainage, surface evaporation and growing vegetation.
2. Normal rainfall caused a rise in the level depending on the distance of free water from the surface.
3. Long continued irrigation caused a rise in the level.

IRRIGATION EXPERIMENTS WITH SUGAR BEETS. Bulletin No. 186, September 1923. Harris. Pittman.

Results of an experiment on the irrigation of sugar beets continuing over five years are reported in this bulletin. The experiments consisted of applying irrigation water at different times and in different amounts and noting the yield, and sucrose content of the beet crop produced. Some of the conclusions are summarized below.

1. Where a limited quantity of water was used, larger yields were obtained by applying it in several small irrigations rather than in fewer large irrigations.
2. As long as the irrigation was confined to the season between two weeks after thinning and a month before harvest time, its distribution had little effect on the sugar content or purity of the beets.

Mutual Irrigation Companies in Utah. Bulletin No. 199, May 1927. Hutchins.

The mutual irrigation company is defined as a private association of water users, either incorporated or unincorporated, the purpose of which is to obtain and distribute water at cost to the lands of members only. A number of mutual irrigation companies are in existence in Utah and three-fourths of the irrigated land of Utah receives water through the agency of these companies. This bulletin presents the results of a study of the history, operation, and utility of mutual irrigation companies in Utah.

Drainage and irrigation, soil, economic, and social conditions, Delta Area, Utah: Division 1—Drainage and Irrigation conditions

Bulletin No. 255, April 1935. Israelsen.

In recent years many drainage and irrigation projects in the U. S. A. have been confronted with serious financial difficulties. A study of factors influencing the financial condition of certain Utah irrigation and drainage projects has been conducted since 1928 under four different heads, namely, engineering and engineering economics, soil productivity, sociological and economic aspects. This bulletin reports the findings and conclusions under the first head. Three other bulletins reporting the findings under the three remaining heads will be published later. In an introduction the author discusses in general some causes of the financial difficulties of American drainage and irrigation projects. A brief history of drainage and irrigation in the Delta area, Utah, is given. The investigations include study of the design and functioning of drainage systems and their effect on soil alkalis, irrigation water needs, and the problem of culturable land lying idle. Changes in the present policy of drainage and irrigation affairs in Utah are suggested. Finally, conclusions arrived at from the investigations are summarized.

Drainage and irrigation, soil, economic, and social conditions, Delta area, Utah: Division 2—Soil conditions. Bulletin No. 256. May 1935. Jennings. Peterson.

This is the second of a series of 4 bulletins reporting the findings and conclusions of an investigation into the factors influencing the financial condition of certain Utah irrigation and drainage projects. This bulletin contains a study of soil conditions in the Delta area, Utah. Topography of the area is given, soils of the area are described and classified, soil properties, physical and chemical, are discussed, and ratings of the soil types for agricultural purposes are given. Conclusions arrived at from the investigations are given at the end.

DRAINAGE OF LAND OVERLYING AN ARTESIAN GROUND-WATER RESERVOIR: FINAL REPORT. Bulletin No. 259, November 1935. Israelsen. McLaughlin.

This bulletin constitutes a final report of some phases of co-operative drainage studies in Cache Valley, Utah. Waterlogging and alkali accumulation in several tracts of the Cache Valley which overlies an artesian groundwater reservoir, occurred some time ago and investigations were continued for a number of years with a view to acquire knowledge concerning the causes of waterlogging and its prevention. Progress of the work was reported in bulletin 242 and the present bulletin contains the final report of the investigations. Conclusions are summarized at the end.

SOIL-MANAGEMENT AND CROP-PRODUCTION STUDIES. Bulletin No. 270, February 1936. Zobell.

Carbon County district is one of the largest and best coal producing districts in the State. In 1927 an experimental farm was established in Carbon County, in a region where the agricultural resources had only been partially developed This bulletin is a résumé of agricultural conditions and operations studied at the experimental farm. General character of the soils, alkali problems, erosion problems. irrigation and drainage conditions, cultural methods, crop testing experiments, and fertilizer tests are described and discussed.

ROTATIONS AND CROPPING SYSTEMS. Circular No. 103, April 1934. Pittman.

A proper cropping system is of great importance in securing the maximum efficiency in farm management. The selection of a proper cropping system is based on maximum returns from the farm that can be secured without impairing the fertility of the soil. Some of the more important cropping systems, their limitations, their advantages and disadvantages are discussed in this bulletin. There are in the main three cropping systems, the continuous system in which only one crop is grown continuously on the same land for a great many years; the rotation system in which crops are sown in a regular sequence which is repeated, and the 'opportunist' system in which no rules are followed and crops are changed as often as necessary in a haphazard manner. The features of these systems and the advantages and disadvantages of each are discussed.

AUSTRALIA.

Council for Scientific and Industrial Research.

A soil survey of Block E (Renmark) and Ral Ral (Chaffey) irrigation areas. Bulletin No. 42, 1929.
Taylor.
England.

Presents results of soil survey of the areas. The methods of field work and laboratory work are described.

A soil survey of the Woorinen Settlement, Swan Hill Irrigation District, Victoria. Bulletin No. 45, 1930.
Taylor.
Penman.

This bulletin describes the soil types occurring in the Woorinen Settlement in Swan Hill Irrigation District, and records results of field and laboratory studies of the soil in that area.

Investigations on irrigated pastures.

1. The yield and botanical composition of an irrigated permanent pasture under various systems of pasture management. Richardson.
2. The chemical composition of irrigated pastures at Wood's Point, South Australia. Gallus.

Bulletin No. 71, 1932.

The investigations recorded in the first paper were conducted on reclaimed swamp soil along the lower reaches of the Murray river. In the second paper the effects on the chemical composition of the pasture soil of the various modes of pasture treatment are described.

The establishment, persistency, and productivity of selected pasture species on an irrigated reclaimed swamp. Bulletin No. 80, 1934.
Trumble.
Davies.

This bulletin gives an account of the preliminary and explanatory work involving trials of species, strains, and mixtures of herbage plants suitable for an irrigated reclaimed swamp.

The co-operative development of Australia's natural resources. Pamphlet No. 3, 1923.
Lightfoot.

This pamphlet explains the need of further development of Australia's natural resources, and indicates the lines along which such development is possible.

Methods for the examination of soils. Pamphlet No. 8, 1928.
Prescott.
Piper.

This pamphlet describes methods of soil analysis in detail. Field methods, preparation of samples, mechanical analysis, and chemical analysis are discussed in detail.

THE MECHANICAL ANALYSIS OF SOILS, Pamphlet No. 13, 1929. Piper. Poole.

In this pamphlet details are given of the alterations necessary to bring the method for the mechanical analysis of soils as developed at the Waite Agricultural Research Institute, Australia, into line with a recently developed international method. A number of soils have been analysed according to the old and new standards, and the method of interpolation of results from one system to the other is illustrated.

THE IRRIGATION OF HORTICULTURAL COMMUNITY SETTLEMENTS. Pamphlet No. 26, 1932. Lyon.

The Murray Valley irrigation settlements are horticultural settlements. This pamphlet contains an account of investigations into existing irrigation practices in these settlements with a view to find out the defects in these practices. Suggestions are made regarding the initiation of corrective measures.

THE PREVENTION OF DECAY IN BUILDING FOUNDATIONS. Trade Circular No. 18, 1933.

The decay of timber in floors, joists, bearers, linings, etc., is a source of great loss in ordinary residences. Timber decays because it is not properly handled, used, or protected. This circular describes types of decay, conditions favourable to its development, and spread of decay. Precautions to be taken in preventing decay are set forth in detail. Steps to be taken to eradicate dry rot from buildings are described.

INTERNATIONAL CONFERENCES. ETC.

PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON SOIL MECHANICS AND FOUNDATION ENGINEERING, VOLS. I, II AND III.

The Conference was held from June 22 to 26, 1936 at the Graduate School of Engineering, Harvard University, U. S. A. Vols. I and II contain papers contributed to the Conference. Vol. III contains the Secretary's report describing the purpose of the Conference and its organization and the meetings and other events of the Conference, addresses by the President and other members, discussions on the papers presented, and a few additional contributions of special merit. The papers are grouped under the following sections.

Section A.—Reports from Soil Mechanics laboratories on testing apparatus, technique of testing, and investigations in progress.

Section B.—Exploration of soil conditions and sampling operations. Papers under this section describe the procedure of exploration, sampling and testing of soils as practised in different countries.

Section C.—Regional soil studies for engineering purposes.

Section D.—Soil properties.—A few papers under this section may be mentioned.

1. Shearing resistance of soils.
2. Improved methods of consolidation tests and of the determination of capillary pressure in soils.
3. The chemical nature of soils.
4. Shearing resistance of saturated soils, and the angle between the planes of shear.
5. Report on an investigation of shearing resistance of cohesionless soils.

Section E.—Stress distribution in soils. A few of the papers under this section are :—

1. The stress distribution round a pile.
2. Tangential stresses under a spread foundation.
3. A rational method for the determination of the vertical normal stresses under foundations.
4. A method of representing the distribution of stress in ground.
5. Stress distribution in elastic solids.

Section F.—Settlement of structures. Most of the papers in this section describe settlement observations of a number of structures. and the nature of the foundations of these structures. Conclusions drawn are set forth at the end of some of the papers as regards the causes of the settlement. In some papers the measures taken to prevent further settlement are described. Some of the papers are as follows :—

1. Settlement observations of buildings in Egypt.
2. Movements of building footings due to earthquake loads.
3. Settlement records of the Mississippi river bridge in New Orleans.
4. A case of bridge abutment movement.
5. A case of settlement of a bridge pier.
6. Direct measuring of internal water pressures in clay.
7. Foundation soil testing and settlement measuring.
8. Securing a Vienna house against injurious settlement by reducing the soil pressure and draining the underground.

Section G.—Stability of earth and foundation works, and of natural slopes. In this section the following papers are included :—

1. Stability of foundations of embankments.
2. Stability of earth slopes.
3. The control of landslides.
4. Determination of groundwater tensions, a necessary element in investigating the stability of slopes.
5. Critical height and factor of safety of slopes against sliding.
6. Stability of slopes of natural clay.

All these papers present a mathematical treatment of the subject dealt with Formulae have been derived for use in design. The other papers in this section are :—

7. Bankslides in the Whangpoo river.
8. Foundation investigations of Fort Peck Dam closure section.
9. Uplift pressure on weirs of simple and complex designs : This paper is contributed by Dr. McKenzie-Taylor and Dr. Vaidhianathan of Punjab Irrigation Research Institute and is the only Indian contribution. The paper describes investigations of uplift pressure on weirs with flush and depressed floors and one sheet pile.

Section H.—Bearing capacity of piles. Amongst the papers in this section may be mentioned :—

1. Pre-determination of the required length and prediction of toe resistance of piles.
2. Conditions for the stability of piles.
3. Dynamic formula for determining resistance of piles.

Section I.—Pile loading tests.

Section J.—Earth pressure against retaining walls, excavation sheeting, tunnel linings, etc. Some of the papers in this section are :

1. Distribution of normal pressure on a retaining wall due to a concentrated surface load.
2. Distribution of the lateral pressure of sand on the timbering of cuts.
3. A fundamental fallacy in earth pressure computations. This paper by Dr. Terzaghi discusses Rankine's and Coulomb's theories of earth pressure which were the basis of earth pressure computation until now. He proceeds to show that Rankine's theory is no longer acceptable and Coulomb's theory has its limitations.

Section K. Groundwater movement and seepage. The following papers were contributed in this section :—

1. Electric investigation of underground waterflow nets.
2. On the steady flow of water percolating through soils with homogeneous anistropic permeability.
3. Seepage under an earth dam.
4. The law of distribution of moisture in soils and methods for the study of same.

Section L.—Soil problems in highway engineering including frost action on soils. Papers in this section describe methods of foundation dehydration and stabilization of fills, methods of treatment of compressible soils for heavy traffic conditions, methods of group classification of soils in highway work, field testing of soils and soil survey. The following are some of the papers :—

1. Experimental road for heavy traffic on a very compressible soil.
2. Vertical and lateral displacement of a reinforced concrete culvert under a high earth embankment.
3. Studies of fill construction over mud flats including a description of experimental construction using vertical sand drains to hasten stabilization.

Section M.—Methods for improving the physical properties of soils for engineering purposes including recent developments in constructing and compacting earth fills. There are four papers under this section :—

1. A new method of impermeabilizing and improving the physical properties of previous subsoils by injecting bituminous emulsions. This paper describes a process of making fine water-bearing sandy soils permanently impermeable by injecting a special bitumen emulsion under moderate pressure into the soil.
2. Earth embankments for the Pickwick Landing Dam. This is a dam under construction by the Tennessee Valley Authority. The hydraulic fill construction and other features are described.
3. Electro-chemical hardening of clay soils. A new method, still in the course of development, of hardening clay deposits by electro-chemical process is described.
4. Soil consolidation works effected near Elne, France, on a bridge over the Tech River. This paper describes strengthening of pier foundations by cement injection.
5. Comparative studies of the effectiveness of different methods for compacting cohesionless soils.

Section N.—Modern methods of design and construction of foundations. Most of the papers of this section describe the geology of the foundations and special construction of the foundations of some large works. One paper deals with various types of cofferdam construction. A few of the papers are mentioned below :—

1. Foundation for palace of Soviets : designing a rigid heavy foundation on compressible materials through the use of soil mechanics.
2. Some features in connexion with the foundation of the Svir 3 hydro-electric power development.
3. A special foundation method for bridge piers adopted in Danish fjords.
4. The floating foundation of the new building for the National Lottery of Mexico.
5. Failure of bridge piers due to scour.
6. Concrete filled steel cylinders for foundations.
7. Cofferdams.

Section Z.—Miscellaneous.—The papers in this section likely to be of interest are given below :—

1. Soil mechanics as a practical science.
2. Field investigations of the theory of vibration of massive foundation under machines.
3. Consolidation of marine clay.
4. Experiment with models for determining the deformation and tensions in foundations on plastic ground.
5. Foundations and embankments of Quabbin dams.
6. Improved soil testing methods.
7. A preliminary investigation into the subject of foundations in the 'black cotton' and 'kyatti' soils of Mandalay district in Burma.

LIST OF MEMBERS OF THE PERMANENT INTERNATIONAL ASSOCIATION OF NAVIGATION CONGRESSES, NOVEMBER 1936.

BULLETIN OF THE PERMANENT INTERNATIONAL ASSOCIATION OF NAVIGATION CONGRESSES, NO. 23, JANUARY 1937.

CHARACTERISTICS OF COHESIONLESS SOILS AFFECTING THE STABILITY OF SLOPES AND EARTH FILLS. Casagrande.

The writer discusses the meaning of the term stability, the relation between stability and shearing resistance, the shearing resistance of cohesionless soils, and the volume changes associated with the deformation of soils during shearing tests. The effect of volume changes during deformation on stability is considered, and effect of disturbances on the stability of cohesionless soils is illustrated by means of some experiments. Methods for compacting cohesionless soils are discussed. The conclusions of the writer are :

1. Every cohesionless soil has a certain critical density in which state it can undergo any amount of deformation without volume change. If the soil is below critical density it can stand any disturbance without danger of flow or slide.
2. The density of many cohesionless soils is above the critical density. Such materials change in volume if subjected to deformation causing slide.
3. Cohesionless soils above critical density can be efficiently compacted and stabilized by special vibration machinery.

THE PROBLEM OF RIVER-BORES. Masse.

The principal aspects of the phenomenon of tidal bores in rivers are set forth, and an explanation of the cause of the phenomenon is put forward. A theoretical study of tidal bore phenomena is made based on fluvial hydrodynamics. Two laws governing the occurrence of bores are derived as a result of the theoretical analysis of the problem.

THE CLASSICAL THEORY OF EARTH PRESSURE. Jaky.

A study of earth pressure theories offering a solution of the problem of earth pressure on the basis of a curved sliding slope for cohesionless soils. The existing earth pressure theories of Coulomb and Rankine are reviewed and their deficiencies are pointed out. Earth pressure with a curved sliding slope is discussed, and an equation for the sliding slope is evolved. Graphical solutions of this equation are given.

REPORT ON THE SECOND INTERNATIONAL CONGRESS FOR BRIDGE AND STRUCTURAL ENGINEERING HELD IN BERLIN AND MUNICH FROM 1ST TO 11TH OCTOBER 1936. Whishaw.

Major W. B. Whishaw, R.E., attended the Congress as the representative of the Government of India. In this report he describes in brief the proceedings, and gives a brief account of the works he visited in Germany, which include a number of bridges, modern roads with concrete trackways, and the test house in Berlin. He brings to notice a few interesting developments which include steel houses, reinforced concrete shell roof construction of hangars, and pre-stressed reinforcement in the manufacture of piles, columns, inverts, walls, beams, arches, pipes and roads.

The papers read at the Congress are arranged under different themes. Summaries are not given, but conclusions under the different themes are recorded. The themes are as below :—

1. Importance of the toughness of steel for calculating and dimensioning steel structural work. 8 papers.
2. Stressing and degree of safety in reinforced concrete structures from the designer's point of view. 10 papers.
   - (*a*) Influence of stationary and repeated loading.
   - (*b*) Means for increasing the tensile strength of concrete.
   - (*c*) Use of high tensile steel.
   - (*d*) Influence of concreting and dilation joints.
3. Practical questions in connection with welded steel structures. 25 papers.
4. Recent points of view concerning the calculation and design of bridge and structural engineering in reinforced concrete. 10 papers.
   - (*a*) Walled structures.
   - (*b*) Wide span bridges.
5. Theory and research work on details for steel structures of welded and rivetted construction. 12 papers.
6. Concrete and reinforced concrete in hydraulic engineering. The following papers are mentioned under this head :—
   - (*a*) Development and analysis of arch Dams. (German).
   - (*b*) The use of concrete in construction of solid dams. (French).
   - (*c*) Reinforced concrete piles during driving. (English).
   - (*d*) Use of concrete in dam construction in Germany. (German).
   - (*e*) Reinforcements of pressure pipes for the Mareges plant. (French).
7. Application of steel in bridge and structural engineering and in hydraulic construction. 14 papers.
8. Research concerning building ground : soil studies and soil tests. 4 papers.

MINUTES OF PROCEEDINGS OF THE MEETING OF THE SUB-COMMITTEE ON SPECIAL CEMENTS OF THE INTERNATIONAL COMMISSION ON LARGE DAMS, HELD IN LONDON ON THE 16TH APRIL 1937. (In French).

The following are some of the questions dealt with :—

1. Methods of testing (*a*) Permeability, (*b*) Action on cement on water filtering through concrete, (*c*) Heat of hydration.
2. Shrinkage of mortar and concrete.
3. Methods of testing the action of Pozzuolana.
4. Methods of measuring the fineness of cements.
5. Text of an industrial specification for cement for dams.

OTHER PUBLICATIONS.

THE NATIONS WATER SUPPLY. (The publication is available in the Imperial Secretariat Library and not in this office). Walters.

This is an interesting book recently published containing a general description of the sources of water supply in Great Britain and the factors affecting them. The book is divided into eight sections of which the first three are of a general nature and of universal interest.

The first section deals with rainfall in relation to water supply. In Great Britain the flow of streams is estimated from rainfall observations and not by actual measurements of river discharges as in America. The average rainfall over a period of 35 years is generally used in England for determining run-off and flow of streams. It is estimated that the net loss of rain water from evaporation, absorption and other causes varies from 13 inches to 20 inches per year according to nature of soil.

The second section deals with geology in relation to water supply. The importance of a full knowledge of the geology of sites for locating dams is stressed. Instances of failures of dams due to faulty locations are given.

Section three deals with the chemical qualities of water in reservoirs and the subsoil. Hard and soft waters, softening hard waters and contamination of water are discussed.

Sections 4 and 5 describe the water resources, upland and underground, that have been developed in Great Britain and comprise the water supply schemes of some of the important towns and counties. Section 6 describes a few typical river installations for water supply.

Section 7 gives a short history of the origin and growth of water undertakings and the sequence of legislation on water supply up to the present day.

Section 8 describes in outline some engineering works appurtenant to water supply schemes, such as impounding reservoirs, wells, boreholes, pumping machinery etc.

NOTE ON THE POLICY OF IRRIGATION IN INDIA WITH PARTICULAR REFERENCE TO FUTURE DEVELOPMENT AND FINANCE. Curry.

With an ever increasing population and improved methods of treating diseases and epidemics, an increase in the growth of food crops is vitally necessary in India. The note indicates the lines along which an increase in the area under crops can take place. Linked with the question of increasing the area under crops is the question of increasing facilities for irrigation. In Provinces where cold weather discharges are fully utilized, further developments are only possible through increased use of flood season supplies, storing flood water, lift irrigation from rivers during the flood season by electricity or otherwise, and by improving the efficiency of old inundation canals. Reclamation of water-logged areas by drainage and pumping is necessary to increase area under crops. Conditions in Bengal are discussed, and it is stated that in years of drought, crops suffer very much. Impounding reservoirs are necessary to make water available in drought seasons. For deltaic areas a policy of reclamation of low areas should be initiated. In view of the indirect returns from irrigation projects the present criterion of 6 p.c. return on outlay for a profitable project should be reduced to 3 or 3½ p.c. Increasing the fertility of the soil is also closely connected with the problem of increasing area under crops. Means of increasing fertility are discussed.

NOTE NO. 43 OF JANUARY 1937, ON AFFLUX EXPERIMENTS WITH A MODEL OF A WEIR FOR THE ALANDI WATER SUPPLY PROJECT—CARRIED OUT AT THE HYDRODYNAMIC RESEARCH STATION AT LAKE FIFE, POONA.

Describes the experiments to determine afflux in a weir with models of different profiles, and presents the results. The dynamic force acting on the weir has been worked out mathematically.

LETTER DATED 17TH MAY 1937, FROM MR. C. C. INGLIS, TO MR. M. R. RICHARDSON, REGARDING EXPERIMENTS TO ASCERTAIN THE BEST METHOD OF PROTECTING THE DOWNSTREAM PAVEMENT OF SARDA BARRAGE AT BANBASSA.

Mr. Inglis states that in all experiments comparing arrows with deflector-bafle design, arrows have been found inferior for dissipating energy and safeguarding structures. No experiments have so far been done to determine the effect of the slope deflector during the break up of the talus. In connection with the Sarda Barrage investigations, further experiments will be carried out on this question. In connection with the Bhimgoda weir in the United Provinces it has been decided to allow the loose talus to scour down to a slope of 1 in 3 before taking any action. Mr. Inglis considers this policy dangerous and has given reasons in support of his opinion.

LETTER DATED 21ST MAY, 1937, FROM MR. C. C. INGLIS, TO THE EDITOR, ENGINEERING NEWS-RECORDS, NEW YORK, REGARDING CLOUDBURST FLOOD FORMULA BY GUTMAN.

Mr. Gutman evolved a formula for discharge of Cloudburst floods for limited areas of 1 to 70 sq. miles. (See page 52 of Bulletin No. 4). Two other commentators considered this formula incorrect as it gives flows far below those actually observed in Texas. Mr. Inglis has given another formula suitable for all catchments which agrees with Gutman's formula fairly well. This formula has the merit of being applicable to all discharges and not limited discharges as the Gutman formula. Mr. Inglis considers the Texas floods of unusual magnitude and the figures differ so markedly from the rest of the world that they are of no importance outside the area.

A MEASURING DEVICE FOR IRRIGATION EXPERIMENTS. (REPRINTED FROM SCIENTIFIC AGRICULTURE, JULY 1936).

Fleming.

Describes a device for measuring irrigation water applied to individual rows. This device may be used where water can be delivered into it by stand pipe or hose or by gravity from a carrier flume at least 2 ft. above the ground. The water is measured in gallons.

LETTER NO. 175, DATED 20TH MAY 1937, FROM MR. INGLIS TO MR. MIRCHANDANI REGARDING SPIN KAREZ RESERVOIR PROJECT.

Mr. Inglis examined the data of the Spin Karez Reservoir Project (See page 13 of Bulletin No. 3) for the water supply of Quetta. The slope of the Spin Karez river approximates 100 ft. per mile, and if the river carries a heavy supercharge of silt during floods, the silt will be deposited in the reservoir and the clear water flowing out over the waste weir will scour the river. If the bed consists of boulders of 6" average diameter and over a steep slope of the order of 100 ft. per mile can eventually be made stable.

NOTE ON THE MALAKAND HYDROELECTRIC SCHEME.

The construction of the Malakand Hydroelectric scheme was commenced in December 1934, and the first stage of development is expected to be completed and put into service by December 1937. The power station is situated in Malakand Agency near Malakand. It will contain in the first stage three 3,200 kw, 11,000 volt, 3 phase water turbine driven generating sets and is designed for extension up to six such sets. One of these sets is regarded as a stand by and the initial output will be 6,400 kw. The grid system comprises 4 substations at Mardan, Nowshera, Peshawar and Charsadda, which will be the sources of electric power for all towns and villages in the district. Power will be supplied in bulk to the Military authorities for Peshawar, Nowshera, and Risalpur Cantonments. 35 p.c. of the power will be used for bulk supply, 30 p.c. for industrial use, 20 p. c. for domestic use, 10 p. c. for irrigation and 5 p. c. for public lighting. The industrial load will be derived mostly from agricultural requirements such as flour mills, sugar mills. woollen mills, cotton ginning etc. The scope for irrigation is not very large. The rates are as follows for bulk supply, 6 pies per unit; for industrial use 6 to 8½ pies per unit; and for metered supply 4 annas per unit. Local distribution in towns and villages will be undertaken by Government.

SOME CHEMICAL METHODS OF WEED DESTRUCTION. REPRINT FROM THE JOURNAL OF THE ROYAL AGRICULTURAL SOCIETY OF ENGLAND. VOL. 96. 1935.

Long.
MacDowall.

The destruction of weeds by the use of chemicals is a recent development. This pamphlet gives a brief account of weed destruction by sulphuric acid, calcium cyanamide, chlorates. and ammonium thiocyanate, and describes the machinery and other equipment required for the distribution of the chemicals. Sulphuric acid, sodium chlorate in solution, and ammonium thiocyanate in solution are sprayed on to the field by special spraying machines. Calcium cyanamide is dusted on to the field by a power blower machine specially constructed for this work. The conditions of use, limitations, effect on vegetation and crops, and other particulars regarding the use of the chemicals mentioned above are discussed in detail. The spraying and power blowing machines are described in detail with illustrations.

NOTES ON THE PRINCIPLES AND FORMULAE ADOPTED IN THE DESIGN OF THE "STANLEY" AND "PERIYAR" DAMS IN MADRAS.

The dams are of masonry and of the gravity type. Maximum stresses are calculated by Bouvier's method.

THE GOVERNMENT CLERK'S COMPANION. Keymer.

A book on office procedure for the use of entrants in Government offices.

STABILITY DIAGRAMS OF DAMS IN THE DECCAN IRRIGATION CIRCLE.

Contains stability diagrams of :—

(1) The weir at Vir, Nira L. B. Canal.

(2) The Wilson Dam.

(3) The Darna Dam.

(4) The Chankapur Dam.

(5) Nandur Madhmeswar Weir.

All the above dams and weirs are of masonry.

NOTE ON THE RISE IN WATER-TABLE IN THE CANAL IRRIGATED AREAS OF THE PUNJAB AND ON WATERLOGGING. McKenzie-Taylor

In this note Dr. McKenzie-Tylor discusses the question of the rise of water table in canal irrigated areas of the Punjab. He differentiates between local waterlogging as in the vicinity of canals and a general rise in the water table. A study statistical methods of factors responsible for rise in the general water table led him to the conclusion that there was high correlation between rainfall and variations in the level of the subsoil water table, and the effect of irrigation on the general water table was small. Local waterlogging as in the vicinity of canals is more prevalent along canals in regions of high general water table. A further factor influencing local waterlogging is the blocking of drainages. In his opinion, rainfall assisted by blocked drainages is the controlling factor in the rise of the general water table, and he considers removal of rain water as the most important remedial measure. He does not think that canal closures are of any use as anti-waterlogging measures.

In certain cases examined, there is no correlation between rise of water table and either the rainfall or irrigation. A probable explanation is the flow of water in the subsoil in such areas from adjoining high water table areas. His conclusions are

(*a*) that local waterlogging depends on the state of the general water table,

(*b*) the general water table varies with rainfall in the northern parts of the Doabs, and he recommends that in the upper reaches of the Doab, measures for the removal of rainwater should be introduced. Seepage from canals has a local effect but if the seepage is very high canals, should be lined. It would be advisable to line canals in salty reaches.

NOTE DATED 7TH AUGUST 1935 ON DR. MCKENZIE-TAYLOR'S NOTE ON THE RISE IN WATER TABLE IN CANAL IRRIGATED AREAS OF THE PUNJAB.

Crump.

Mr. Crump finds it difficult to accept the views expressed in Dr. McKenzie-Taylor's note as to the relatively small effect of irrigation water on the water table. He visualizes the ground water stream as a moving mass of pitch flowing towards a capacious sink. A spray of pitch would represent rainfall and a curtain of pitch would represent the seepage from canals and rivers. He argues that in a statistical investigation of changes in the surface level of the water table, we can only express the changes as a function of the incidental and fortuitous changes in the various sources contributing to the deviations in surface level of the subsoil water table. If there is no variation in a particular source it is utterly impossible to ascertain its effect. The greater the variation in a particular source the more predominant is its effect in statistical analysis. In actual fact variations due to contribution from rainfall from year to year are much more marked than variations due to seepage from canals and field irrigation. In investigating the effects of various causes by statistical methods, the relation between the slight variation in surface level due to the small variation in seepage and field irrigation, may have been masked by the much more marked relation between large variations in surface levels due to the wide variation in rainfall. With the picture of the pitch model before us there appears to be no reason why a given volume of water added as seepage should not have the same effect as the same volume falling as rain, on the water table. He is of opinion that subsoil water table rise is roughly due 2/3rd to rainfall and 1/3 to irrigation water.

COMMENTS ON MR. CRUMP'S NOTE ON THE NOTE BY DR. MCKENZIE-TAYLOR ON THE RISE IN WATER TABLE IN CANAL IRRIGATED AREAS OF THE PUNJAB.

McKenzie-Taylor.

Dr. McKenzie-Taylor says that actual flow of water from one point to another is not necessary for a rise in water table at the second point. All that is necessary is transmission of pressure from the first to the second point. The picture of the pitch model visualized by Mr. Crump does not conform to this aspect. He considers that the statement of Mr. Crump, that the greater the variation in a particular source the more predominent is its effect in statistical analysis is wrong. A large range of variation is not always associated with high correlation or *vice versa*. He says that irrigation is also a variable source as it is reduced in years of heavy rainfall. Rainfall is only one factor and its magnitude and high correlation place it as the predominent contribution to the rise of water table. In both rainfall and irrigation there is an immediate rise in the water table under the area in which the water falls or which is irrigated. In the case of rainfall there is a considerable lag in recovery of the water table to its original level while in the case of irrigation the recovery is rapid. This is due to the fact that in the case of rainfall the water table rises simultaneously over a large area while in the case of irrigation the rise is in a small portion of the total area. From this consideration alone rainfall would produce a more permanent effect upon the water table than irrigation.

EXTRACT FROM FORWARDING MEMO. NO. G.-160, DATED 15TH APRIL 1936, FROM THE SUPERINTENDING ENGINEER, NORTHERN SIND, CIRCLE, TO THE CHIEF ENGINEER IN SIND REGARDING "MATERIAL CARRIED IN SUSPENSION IN WATER".

His impression is that material carried in suspension in water contains a very small amount of sand greater than 0·075 m. m. equivalent diameter as determined by sedimentation methods. All other material greater than ·075 m. m. diam. moves by saltation along the bed and rises very little above it. As velocities decrease the materials of larger size settle down till a velocity of 1·25 to 1·0 ft. per sec. is reached at which the 'sandy' portions of the suspended matter settle down to some extent. Sloughing of the sides of channels he thinks is largely due to scour in the bed which results in a withdrawal of support from the toe of the slope. Many such cases have occurred on the Rohri Canal where the material of the berm is made up of particles up to ·075 m. m. diameter. Such material is resistant to scour and does not slough in if the canal bed is stable.

DISCHARGE AND SILT OBSERVATIONS No. 3, ABKALANI OF 1934, AND No. 4, COLD WEATHER 1934-35, ROHRI CANAL.

DISCHARGE AND SILT OBSERVATIONS, RIVER INDUS.' 10TH NOVEMBER 1934 TO 26TH FEBRUARY 1935.

DISCHARGE AND SILT OBSERVATIONS, 6 RÉGIME SITES ON THE JAMRAO CANAL.

REPLIES TO QUESTIONNAIRE ON MEANDERING OF RIVERS. Claxton.

The subject of tortuosity of rivers is being investigated by the Central Board of Irrigation and a questionnaire on the subject was circulated to obtain data and information from all sources. Mr. Claxton's replies are contained herein.

NOTE ON SILT LOAD ON THE BEHAVIOUR OF RIVERS. Claxton.

The writer gives some figures to show the enormous amount of silt load carried by rivers to the sea and states that eddying motion caused by irregularities in the bed and banks of a river is responsible for the processes of saltation and suspension whereby materials heavier than water are carried to the sea. He then attempts to show the effect of the silt load on the behaviour of the rivers. He differs from the general view that rivers assume a tortuous course to coordinate velocity to resistance of banks, and believes silt load to be the main influencing factor. His experience is that silt eroded from one bank is deposited on the same bank lower down. He refers to experiments of Gilbert and Murphy on silt transportation in California and discusses their findings as to the effect of the silt load on the stability of the river bed. He explains why a stream with diminishing silt load will scour its bed by retrogression of levels. Formation of shoals and attainment of regime conditions in a river bed are discussed.

He next deals with silt eroded from banks and carried forward by the river and forwards a theory regarding meandering of rivers. According to this theory, a river strikes a bank, erodes it, the eroded material is carried in suspension till the load is so large that it cannot be carried any further, and is deposited, as a shoal. The potential force of the moving silt load produces in reaction a strong turning force which causes a change in direction and carries the stream over to the other side. He describes a number of actual instances of river action in his own experience in support of his theories.

CORRESPONDENCE REGARDING INFORMATION ON "BENTONITE".

Bentonite is a material being used in America to prevent water seepage. In India this material is available in Kashmir and Jodhpur. The Senior Geologist, India, of the Burma Oil Co., Ltd., in a letter to the Secretary, Central Board of Irrigation gives a method of treatment of the Kashmir material so that it may be suitable for prevention of seepage through dams. The Jodhpur material according to him is not so amenable to treatment. The treatment consists in changing the naturally occurring material from calcium bentonite to sodium bentonite by base exchange with soda ash.

COPY OF A LETTER DATED 7TH APRIL 1937, FROM MR. P. EVANS, SENIOR GEOLOGIST, BURMA OIL CO., LTD., (INDIA) TO THE SECRETARY, CENTRAL BOARD OF IRRIGATION REGARDING THE "USE OF BENTONITE IN CANAL LINING".

In reply to a letter from the Secretary, Central Board of Irrigation enquiring whether in his opinion "bentonite" is likely to prove effective as a lining for earthen channels, Mr. Evans thinks that the suggested use of bentonite to provide a water tight lining is worth a trial. It may be possible to prepare a slurry of sodium clay, treat it with bentonite and spray the mass over the bed and banks of a canal. He suggests the inclusion in the slurry of ground sugarcane waste or some form of fibre. Another method suggested is to treat the sodium clay slurry with small quantities of magnesium oxide.

THE CHARACTER, PROPERTIES, AND POSSIBLE USES OF BENTONITE, A SODIUM CLAY.

Woodman.
McKenzie-Taylor.

Reprint from the Journal of the Society of Chemical Industry, May 31, 1929, Vol. XLVIII.

Bentonite is defined as a colloidal clay occurring in large expanses in Canada and America. It swells considerably in wetting and absorbs large quantities of water. Its chemical composition is discussed, and it has been proved to consist mainly of sodium clay. A preliminary investigation of the use of bentonite as an emulsifier for such oils as kerosene, red engine oil, etc., was made some years ago. These are described and the results are tabulated. It is found to be a good emulsifier for certain oils.

THE EMULSIFYING POWERS OF BENTONITE AND ALLIED CLAYS, AND OF CLAYS DERIVED FROM THESE BY BASE EXCHANGE AND BY HYDROLYSIS. **Woodman. McKenzie-Taylor.**

Some experiments were carried out to determine the possible use of bentonite as an emulsifier. The method of experiment is described and results are presented and discussed. Similar experiments with other natural clays and derivatives of these were also carried out and results are discussed.

SUGGESTIONS DATED 3RD JUNE 1937, REGARDING QUESTIONNAIRE ON CONDITIONS PREDISPOSING TO HARMFUL SOIL SATURATION WHICH MAY ULTIMATELY RESULT IN WATERLOGGING. Inglis.

Mr. Inglis suggests that replies to the Questionnaire should be arranged in 4 sections :-

(1) General, pertaining to alluvial tracts of Northern India;

(2) pertaining to Deccan; and

(3) pertaining to Bengal.

He also suggests a new definition of waterlogging.

COMMENTS ON MR. GERALD LACEY'S NOTE ON "VISCOSITY AS A FACTOR IN THE FLOW OF WATER IN OPEN CHANNELS". Bose.

Dr. Bose says that the following assumption of Mr. Lacey cannot be accepted as valid :—

"Effectively if we have a number of equations correlating hydraulic data, whatever forms these equations may take, they can only be correct when all the observations have been taken at the same temperature".

Dr. Bose says that for fluids of very small viscosity such as air or water or fluid movement with a high Reynold's number where the turbulence is very high, excepting for a small layer near the boundary, viscosity plays no part in the outside volume of the fluid and temperature will have no direct effect. Observations in the Punjab on regime canals in alluvium are stated to disprove Mr. Lacey's assumption and bear out Dr. Bose's contention.

NOTE ON TRAPEZOIDAL FLUME OUTLETS. Brown.

In connection with the design of an outlet that would discharge proportionately to the parent channel discharge throughout the range of fluctuation of discharge for which the kharif channels of the Sutlej Valley Project have been designed, a convergent trapezoidal flume outlet was designed. The author on working out the theory of trapezoidal outlets found that a divergent trapezoidal flume outlet was more suited for the purpose and his theoretical discussion is appended. It was thereupon decided to build a convergent and a divergent outlet for identical conditions, and to test them. The designs of the outlets and the experimental observations on them are given and also their discharge curves. The experiments confirmed the theory that a divergent outlet could be designed for a smaller variation in flexibility than a convergent one but neither outlet appeared to be a practical proposition owing to the difficulty of constructing them.

The differences between the theoretical and actual discharges through the outlets as observed are attributed to friction, and the effect of friction on the discharges is discussed theoretically. A second divergent outlet was designed to test the friction theories and experimental results are presented. The author is doubtful whether these outlets would ever be a practical proposition. He suggests experimenting with another type of outlet in which the lower part of the divergent section is made in the form of a rectangle of equal area to the trapezoid. He discusses the theory of this form of outlet and says that if further experiments are contemplated, they should be directed to this new form of outlet.

NOTE ON THE DESIGN OF A. P. M. CUM FLUME PROPORTIONAL OUTLETS. Brown.

In connexion with the design of outlets required to discharge proportionally to the parent channel discharge throughout a wide range of variation in the parent supply, the author indicates the possibilities of a combination of an A. P. M. outlet and a broad crested flume outlet. An alternative combination of two A. P. M. outlets is also considered. It is shown how these combinations should be designed to secure the best results. The theory forming the basis of design is discussed and rules for design are summarized. A few examples of design are also given. These combinations have not so far been tested experimentally.

COPY OF A LETTER DATED 10TH APRIL 1937, FROM CHIEF ENGINEER, BENGAL TO THE SECRETARY, CENTRAL BOARD OF IRRIGATION REGARDING "GENERATION OF ELECTRIC POWER FROM CANAL FALLS AND WATER REQUIREMENTS FOR PRINCIPAL IRRIGATED CROP IN BENGAL".

In his opening speech at the Seventh Annual meeting of the Central Board of Irrigation His Excellency the Viceroy suggested the consideration of the possibility of hydro-electric development in future irrigation schemes. The minutes of the Proceedings of the meeting were forwarded to Members of the Board and this letter is in connection therewith.

The Chief Engineer writes that no perennial canal is in operation yet in Bengal and the use of canal falls for generating electric power is impracticable. Arrangements will be made in the storage dams for the Mor and Darakeswar Canals for generation of power and the falls on those canals can also be utilized for the same purpose.

Requirements of water for paddy as determined in Bengal are given for the period June to November. The total requirement is 40 inches of which 20 inches are required in June and July. The amount of 40 inches total depth is held to be the minimum necessity in Bengal.

COPY OF A LETTER DATED 2ND APRIL 1937, FROM CHIEF ENGINEER, BURMA TO THE SECRETARY, CENTRAL BOARD OF IRRIGATION REGARDING "HYDRO-ELECTRIC DEVELOPMENT IN BURMA".

The Chief Engineer says that the irrigation systems in Burma do not lend themselves to hydro-electric development. All systems except one operate during the rains. Water table is very low and irrigation by pumping is impracticable. The rivers with one exception have a very small discharge from December to May.

COMMENTS ON MR. GERALD LACEY'S NOTE ON "VISCOSITY AS A FACTOR IN THE FLOW OF WATER IN OPEN CHANNELS".

Malhotra.

Mr. Malhotra says that Mr. Lacey's formulae were deduced by a process of graphical analysis of hydraulic data. An exact discussion of the flow of water in our present state of knowledge is neither possible nor available and so it must be conceded that finality in the subject is still far from being attained. The formulae are therefore subject to the usual limitations of others of the same class obtained by statistical analysis. With regard to the assumptions that factors containing kinematic viscosity and gravity can be obtained by dimensional analysis, he says that dimensional analysis is not valid unless it is shown that no other variables exist. Dimensional analysis can only serve as a verification and not as a proof of the correctness of the formulae which must be obtained by other methods. He further says that gravity (g) is a constant throughout the world and should not figure at all in a dimensional analysis. The formulae in their new form therefore cannot be taken to be proved even if the results obtained are dimensionally correct.

He welcomes Mr. Lacey's assumption that his silt factors have the dimensions of an acceleration because it gives a physical meaning to the silt factor. There is some confusion as to the relations of the various silt factors and he has given an analytical discussion in which he arrives at some relationships which are the converse of what Mr. Lacey has deduced. The point he says needs elucidation.

SKETCHES OF THE LIVES OF FOUR EMINENT ENGINEERS.

Contains brief life sketches of Lt.-General J. G. Fife (who retired as Chief Engineer of Irrigation Department, Bombay in 1876), Mr. Arthur Hill, C.I.E. (who was Chief Engineer, Bombay, about 1910), Mr. H. F. Beale (who was Chief Engineer, Bombay, about 1916) and Sir C. S. C. Harrison, Kt., C.I.E. (who was Chief Engineer in Sind, about 1932).

REMARKS BY D. V. JOGLEKAR ON A PAPER ENTITLED "THE HYDRAULIC JUMP OVER OGEE SPILLWAY DAMS: DEVELOPMENT OF FRICTION FACTOR '*n*' IN MANNING'S FORMULA FROM OBSERVED DATA ON A HIGH CRESTED OGEE DAM" BY J. L. SOUTHWORTH.

Joglekar.

He says that in general this method (given by Mr. J. L. Southworth) of finding the depth of water from values of *n* does not appear to be sound.

IRRIGATION FLOW DIVISORS.

This is a pamphlet issued by Messrs. Neyret-Beylier and Piccard-Pictet (N. B. P. P.), France. It describes, with illustrations, their patents for special devices applicable to irrigation division flow problems, *e.g.*, Weir with conical sill and rotating splitter; Weir with special check, forming an automatic locking or module with quasi-constant flow; Proportional divisor for steep flumes; Automatic gate with constant upstream level; Gate with a constant downstream level; and Butterfly valve with a constant flow. The application of these devices, in respect to both proportional and take-off division, is also described.

AUTOMATIC CONTROL OF RIVERS AND CANALS.

This is a pamphlet issued by Messrs. Barrages Automatiques, Ltd., and describes by illustrations their twelve types of automatic gates as well as the works where they have been applied.

WATER WORKS FITTINGS.

This is a catalogue of the appliances made by Messrs. Glenfield & Kennedy, Ltd.

WEEDS. (Rural Science Series). Muenscher.

This book deals quite comprehensively with weeds as affecting growth and yield of agricultural crops and also the strength of soils. It is divided into two parts. Part I is devoted to a consideration of those characteristics and habits of weeds by which they affect other plants or interfere with man's activities, and also to the methods employed for their eradication and control. In Part II is brought together data concerning the names, duration, reproduction, dissemination, habitat, range, source, recognition, and control of the commonest weeds of the Northern United States and Canada. Particular emphasis has been given to identification and control.

CONTRIBUTION TO THE STUDY OF THE WATERS AND SILT OF THE NILE (In French). Mosseri.

This is a posthumous work of Victor M. Mosseri. It contains results of chemical analyses of Nile water, and chemical and mechanical analyses of Nile silt.

MAPS, BLUE PRINTS AND PHOTOGRAPHS.

United Provinces.

Salawa Power Station :

Photograph showing automatic gate on main canal fall at Salawa. 20th April 1936.

Photograph of Salawa Power Station, downstream view. 20th April 1936.

Plan of Concrete work in connection with the installation of two automatic gates 4¼′ × 40′.

Drawing of four automatic gates (pivoted weirs) at Salawa and Chitaura Power Stations. Width 25′—1″, and height 5½′.

Plan of Concrete Work (Reinforcing rods) in connection with installation of two automatic gates 4¼′ × 40′.

Plan of Concrete Work in connection with installation of two automatic gates of height 5½′ and length 25′—1″.

Chitaura Power Station :

Plan of Concrete Work (Reinforcing rods) in connection with installation of two automatic gates of height 4¼′ and length 40′.

For the drawing of automatic gates at Chitaura Station see also under "Salawa Power Station".

Punjab.

Thal Project:

Kala Bagh Weir Plan: Counterbalanced tilting radial gates. (Proposal II). 3rd July 1936.

For a proposed design of an automatic falling shutter for a weir, see under "General".

Bombay.

Madleri Tank:

Cross Section. 17th November 1933.

Sind.

Drawing showing arrangement for lowering electric current meter.

Drawings showing details of lowering electric current meter.

Baluchistan.

Typical cross section of the Spin Karez Dam, Baluchistan.

N.-W. F. P.

For plans of river behaviour of the Indus see under "General".

Indian States.

Gwalior.

Photograph of Harsi Dam.

Photograph of Kaketo Dam.

Burma.

Myaungyan-Minhla Tank, Meiktila Irrigation Division:

Section of Bund No. 11, at breached portion in 1935.

Section of Bund No. 12, at breached portion in 1935.

Section of Bund No. 13, at breached portion in 1935.

Section of Bund No. 14, at breached portion in 1935.

General.

Plan of Type or Generalization of Aluvial River.

Section of Type Alluvial River.

Plan showing River Behaviour of Indus near Kala.

Survey Plan of River Behaviour of Indus opposite Dera Ghazikhan showing position of the river in 1927-28, 1930-31, 1931-32, 1932-33, 1933-34 and 1934-35.

Plan showing River Erosion and Shoaling of river Indus at Lundi 1931-32.

Plan showing proposed design (Designed by Mr. Wheatley, Superintendent, P. W. D. Central Workshops, Amritsar) of an automatic falling shutter for a weir.

NEWSPAPER CUTTINGS.

IRRIGATION IN MYSORE: CONSTRUCTION OF NEW RESERVOIR. March 30, 1937.

Review of the Mysore Public Works Department's work for the year 1935-36. The construction of the Anjanapur Reservoir, of anicuts across the Bhrugu, near Halsur, and across the Maralwadi and Vrishachavati rivers are among the major works. The new tank at Nidsala was also completed. Fourteen out of the 55 major tanks were restored and 53 minor tanks out of 179 were repaired.

The recommendations of the special committee which considered the several aspects of irrigation and power development under the Lakkavalli reservoir scheme are under the consideration of the Government.

TUBE-WELL SCHEME FOR RAMPUR STATE: SIR WILLIAM STAMPE'S SPEECH AT OPENING: INCREASED SOCIAL AMENITIES FOR PEASANTS. April 5, 1937.

The speech was delivered at the opening ceremony of the first instalment of 10 tube-wells out of a scheme of 34. This project was initiated in 1935 as a substitute for the proposed canal from the Gangan river. It is contended that "not only has the capital outlay on the wells been considerably less than that of a river canal but the annual expenses are lower". Electricity for pumping water has been taken from the Salawa Power Station in the United Provinces where it is being generated from the Ganges water falling 15 feet.

DEVELOPMENT OF ELECTRIFICATION IN THE U. P. April 5, 1937.

A U. P. Government press communiqué outlining the policy of the Local Government in respect of the measures to be adopted for the systematic development of electrification, both urban and rural, in the eastern districts of the United Provinces, was explained in a press communiqué published on January 1, 1937. The present communiqué outlines the steps which have since been taken to implement that policy.

A steam generating station and the pumping plant are being constructed near Fyzabad and it is hoped that these works will be in operation in August 1937 and will irrigate an area of 44,000 acres, and secure cheap power for local tube-wells and village industries.

The so-called "Eastern Grid Project" which is being examined by Messrs. Sir Alexander Gibb and Partners, Consulting Engineers, Westminster, comprises the construction of a hydro-electric power station on the Garai river in the Mirzapur district together with the necessary aqueducts and pipelines and an impounding reservoir on a tributary of the Karamnasa river. It is considered that some 8,000 K. W.'s can be made available from this station.

The feasibility of generating a similar quantity of power on the Tons river in the Rewa hills is also under discussion with that State.

For irrigating the Fyzabad and Benares districts a reconnaissance is now being conducted to ascertain the geological suitability of the sub-soil for a system of tube-well irrigation. Besides serving for the extension of irrigation, the eastern grid scheme will be used for development of minor industries in the towns and larger villages traversed by the system.

ELECTRICITY FOR U. P. VILLAGES: OFFICIAL SCHEME BEING DISCUSSED. April 19, 1937.

Sir William Stampe discussed the scheme of village electrification, which is likely to employ about 200,000 persons, with M.L.As. and other prominent people.

IRWIN CANAL AREA IN MYSORE: DEVELOPMENT PLANS. April 19, 1937.

The Standing Committee for the working of the Krishnaraja Sagra Irrigation Works met in camera and it is understood that control of malaria in the area, provision of inter-village roads, a scheme for settling educated unemployed in the area, etc., were discussed. The committee decided to extend the distribution channels to serve the drier regions of Madur, Mandya and Nagamangala in preference to the scheme to extend the Shimsa branch of the canal to the tail lands in Narsipur Taluka.

CONSTRUCTIVE THOUGHT IN RELATION TO DEVELOPMENT: SIR WILLIAM STAMPE ON POSSIBILITIES OF ELECTRICITY SCHEME: ADDRESS TO STUDENTS OF BENARES UNIVERSITY.

The address gives a bird's-eye-view of the system of electrification undertaken by the U. P. Government in the various parts of the Province and mentions the existing works as well as the lines on which further development is possible.

ELECTRICITY FOR IRRIGATION : UTILIZING TUBE-WELLS. May 13, 1937.

New schemes, at present under the consideration of the Punjab Government, include possibilities for an extended use of electrically operated tube-wells for irrigation purposes. One difficulty in the Punjab is that the sub-soil water is saltish in many districts.

CENTRAL BOARD OF IRRIGATION : COMING MEETING AT SIMLA. May 13. 1937.

Refers to the meeting of the Research Committee of the Board in June.

QUETTA SCHEME TO END DROUGHT : KAREZ VALLEY DAM. May 15, 1937.

The present water supply of Quetta depends on the spring at Urak which is at no time more than enough to last for three days. There is thus a proposal to construct an earthen dam 2,375 feet in length with a maximum height of 83 feet in the Karez Valley about 7 miles from Quetta Cantonment. This dam will impound 162,000,000 cubic feet of flood water which although not sufficient in itself to supply the whole of Quetta's needs will supplement the Urak supply in years of drought. The work is expected to take three years to complete and will cost Rs. 8½ lakhs which will be met by the Government of India. (This appeared on page 13 of Quarterly Bulletin No. 3.).

DISTRIBUTION OF WATERS OF INDUS AND TRIBUTARIES : LONG-STANDING DISPUTE ENDED : INDIAN GOVERNMENT ACCEPT INQUIRY COMMITTEE'S PROPOSALS. May 15, 1937.

The Committee was a Sub-Committee of the Central Board of Irrigation convened by the Government of India. Mr. F. Anderson, C.I.E., was the Chairman of the Committee.

USE OF TIMBER FOR BRIDGES : FOREST RESEARCH : NEW TYPE OF MATERIAL AND DESIGN. May 16, 1937.

Review of a pamphlet "Treated Timber Bridges for Indian Highways and Railways" issued by the Forest Research Institute at Dehra Dun.

ADEQUATE WATER FOR QUETTA : 8½ LAKH SCHEME. May 16, 1937.

Same as in the cutting of May 15.

NEW ORIENTATION OF IRRIGATION POLICY : CENTRAL GOVERNMENT'S CIRCULAR. May 17, 1937.

The Circular referred to is not of the Central Government but of the Central Board of Irrigation. The Circular was issued to all Provincial Governments in pursuance of the Board's Resolution at the 7th Annual Meeting in 1936, with a view to eliciting information about the extent of benefits directly or indirectly accruing to the Provincial and Central Governments so that if the benefits accruing to the Central Government be appreciable, that Government should see its way to contribute towards the cost of future irrigation projects, and Provincial Governments should view them from a different aspect.

CENTRAL BOARD OF IRRIGATION: RESEARCH COMMITTEE MEETING IN JUNE: REPRESENTATIVES OF PROVINCES TO ATTEND. May 18, 1937.

IRRIGATION IN INDIA: RESEARCH COMMITTEE TO MEET. May 18, 1937.

These two cuttings refer to the meeting of the Research Committee of the Central Board of Irrigation in June.

CHIEF MINISTER TOURS IRRIGATED TRACTS IN AHMEDNAGAR: CORDIAL WELCOME BY VILLAGERS: POONA LEADERS APPLAUD BOMBAY CABINET'S PROGRAMME. May 18, 1937.

IMPROVEMENT OF SEHERWAH CANALS SYSTEM. May 18, 1937.

A scheme for the improvement of the Seherwah Canals System of the Shikarpur Division estimated to cost Rs. 1,50,000 is being worked out. The scheme includes the construction of three regulators, a new distributary, and the widening or re-sectioning of the entire canal. The scheme is considered necessary, as owing to the shortage of water in the river, there is a deficiency of water on this system of canals.

TAXATION ON WELL WATER: A BILL TO AMEND LAND REVENUE ACT. May 20, 1937.

A bill to amend the Hyderabad State Land Revenue Act is to be moved in the State Council. The effect of the amending bill will be to make the ryots not only sink new wells but also keep old wells in good condition, thus saving the Government from sustaining any loss.

IRRIGATION RESEARCH AT POONA: PREVENTING EROSION BY RIVERS. May 21, 1937.

Gives briefly the results of model experiments conducted at the Poona Research Station on erosion by the river Padma and its probable effect on the Hardinge Bridge at Sara. These experiments were undertaken at the instance of the Railway Board.

WEIRS ON SANDY FOUNDATIONS : SAFE DESIGN EVOLVED BY INDIAN ENGINEER. May 22, 1937.

Says that the problem of weirs on sandy foundations, which has long been baffling irrigation engineers, has been solved and the credit goes to a band of research workers in the Punjab, particularly Rai Bahadur A. N. Khosla, Executive Engineer. Rai Bahadur A. N. Khosla conducted experiments in the field while Dr. McKenzie-Taylor and Dr. N. K. Bose tested them in the laboratory. It is stated that "India is the first to give this design to the world of which full details will shortly be published by the Central Board of Irrigation".

REVENUE SYSTEM IN BENGAL : IMPORTANT CHANGES TO BE MADE. May 22, 1937

It is understood that the Government propose to introduce at the next session of the Bengal Assembly a bill to meet some of the popular demands of the ryots and that the Government is contemplating to appoint a commission to enquire into the whole land revenue system of the province.

BETTERING LOTS OF AGRICULTURISTS : SIRMOOR STATE'S MEASURES. May 22, 1937.

A measure known ts the Peasants' Protection Act will be enacted shortly. The Act aims at affording cheap credit facilities and supplying good quality grain and seed at cheap rates. It also provides against attachment by civil courts of rural stocks and holdings of agriculturists.

Another measure under contemplation is the Land Tenancy Act on the lines of the British enactment.

EROSION OF PADMA : EFFECT ON HARDINGE BRIDGE. May 22, 1937.

Same as in the cutting of May 21, 1937.

TUBE-WELL IRRIGATION IN U. P. : SCHEME SANCTIONED. May 22, 1937.

The Scheme referred to is the U. P. State Tube-well Irrigation Scheme comprising the construction of some 1,500 tube-wells in the western districts of the Province. The scheme has been developed from a series of projects sanctioned as separate estimates under the powers of the local Government but the sanction of the Secretary of State be-became necessary when it was decided to combine these various projects under one consolidated estimate.

TUBE-WELL IRRIGATION IN THE U. P. : WHAT THE GRID SCHEME HAS ACHIEVED. May 23. 1937.

LAND FOR FODDER CROPS : PROPOSAL TO BE DISCUSSED AT CATTLE CONFERENCE. May 24. 1937.

One interesting proposal will be that certain perennial grasses which can be grown where water is available, should be planted on the sides of nullahs where there is leakage from canals or wells.

LACK OF OPPORTUNITY. May 25, 1937.

Referring to the ingenuity of Rai Bahadur A. N. Khosla, who has evolved a safe design for weirs on sandy foundations, says that if opportunities are given Indian talent will be able to prove its worth in every field of human enterprise.

MYSORE ELECTRIC SUPPLY : PLAN TO COPE WITH INCREASED DEMAND. May 27, 1937.

Two schemes for the development of electric supply are under consideration of the State Government. The Shimsa Valley scheme, calculated to produce 15,350 h.p. is expected to cost Rs. 62,00,000. The Gersoppa falls scheme will cost Rs. 1,50,00,000 but is expected to produce only 10,000 h.p.

OUR BIHAR LETTER : FLOODS DUE TO RAILWAY EMBANKMENTS. May 28, 1937.

The letter contains remarks on three Government communiqués dealing with the report of the committees appointed by the Government to report on the problem of floods in North Bihar. One of the conclusions that the committees have reached is that railway embankments are also responsible for aggravating the rigours of floods, but the letter says that the astounding fact is that representatives of the B. & N. Railway have dissented from this.

IRRIGATION RESEARCHES : PROBLEM OF HAVING A CENTRAL STATION. May 28, 1937

Remarks on the fate of the Hydro-dynamic Research Station at Poona, which is being run by the Government of India for the year 1937-38

KARWAR-MADRAS FRONTIER ROAD : CAUSEWAY TO BE BUILT ACROSS BADGANI CREEK, May 28, 1937.

See page 13 of Bulletin No. 4.

IRRIGATION FACILITIES FOR RYOTS : AGRARIAN PROBLEM IN BIHAR CONGRESS KISAN INQUIRY RECOMMENDATIONS. May, 30, 1937.

It is understood the committee will suggest reduction of existing canal rates and imposition of irrigation cess on zemindars where the canal system does not exist.

ELECTRIC POWER FOR MYSORE : SCHEMES FOR INCREASING CAPACITY. June 1, 1937.

Detailed information about schemes mentioned in the cutting of May 25, 1937.

IRRIGATION RESEARCH IN PROVINCES : CENTRAL BOARD'S REPORT FOR 1936-37 : CHEMICAL ANALYSIS OF PUNJAB SILTS. June 1, 1937.

Refers to the Report of the Technical Work done by the Central Board of Irrigation during 1935-36 (not 1936-37). The Annual Report contains minutes of the Research Committee and Annual Board meetings held during the year together with other activities of the Board. (The subjects discussed and conclusions reached at the meetings have already appeared in these Quarterly Bulletins.)

MALARIA AND IRRIGATION PROJECTS : AN AGENCY NEEDED TO CO-ORDINATE PUBLIC WORKS : ENGINEERS AND TRAINING AND SANITATION. June 1, 1937.

Points out the necessity of a co-ordinating agency for forestry, irrigation, agriculture, hydro-electric and public health departments as they are all inter-related subjects. Also says that before any irrigation or railway preject is sanctioned it should be examined by experts in public health, irrigation, agriculture and hydro-electricity.

SURFACE SOIL IN SIND : SATISFACTORY RESULTS OF INVESTIGATIONS. June 3, 1937.

It is said that recent investigations carried on by the Development and Research Division on surface and sub-surface soil have given very satisfactory results which will be useful to other provinces and also to the Agricultural Department.

PUNJAB PERENNIAL IRRIGATION SCHEME : BARRAGE AND CANALS TO BE CONSTRUCTED : PROJECT TO SUPPLY WATER TO HUGE TRACTS OF LAND. June 4, 1937.

Refers to the Haveli Project, preliminary work on which has just started. The scheme comprises five units, namely, Trimmu Headworks on Chenab, Abdul Hakim headworks on Ravi, left bank canals, right bank canals, and Montgomery-Pakpatan link. The scheme is estimated to cost over 5 crores of rupees and is designed to provide perennial irrigation to a gross area of about 700,000 acres besides non-perennial irrigation of about 86,000 acres.

BUTLERGANJ BUND ON THE GOMTI : LUCKNOW BOARD ASKED TO REPAIR : GOVERNMENT THREAT TO SUPERSEDE : June 4, 1937.

The Bund was the property of the provincial Government but the Government ordered the Municipality to repair it as it was contended that the bund was damaged by floods owing to the existence of a weak sewer.

HYDRO-ELECTRICITY IN MYSORE : FUTURE PLANS EXAMINED. June 4, 1937.

IRRIGATION IN THE PUNJAB : UTILIZING INDUS WATERS :PROJECTS OF CRORES OF RUPEES. June 4, 1937.

Gives some features of the Haveli Project, preliminary work on which has just started.

Also says that it is understood that the Thal project has passed the scrutiny of the irrigation experts and that the Government may seek the approval of the Assembly during the next session.

IRRIGATION AND INDIAN ECONOMY : STATISTICS FOR 1934-35. June 5, 1937.

Review of the 1934-35 Statistics issued by the Government of India.

PROGRESS OF CANAL IRRIGATION IN BIHAR : ADMINISTRATION REPORT FOR 1935-36. June 6, 1937.

Review of Administration Report of the Irrigation Department, Bihar and Orissa for 1935-36.

CURRENT TOPICS : FLOOD PREVENTION. June 6, 1937.

Refers to President Roosevelt's message recommending the establishment of seven regional authorities for the prevention of floods, drought and storms.

CURRENT TOPICS : FLOURISHING THE SWORD. June 6, 1937.

Criticises the Government's action in threatening the Lucknow Municipality to repair the damaged bund over the river Gomti. (See cutting of June 4, 1937.)

IRRIGATION SCHEME : RS. 75,00,000 FOR KHAIRPUR STATE PROJECT. June 7, 1937.

The project is designed to remodel the irrigation system in the State and bring it into line with that of Sind. (It is said that the project has been sent up to the Central Board of Irrigation for scrutiny but this is not so.)

IRRIGATED AREAS IN INDIA : 84 PER CENT. UNDER FOOD CROPS. June 7, 1937.

Same as cutting dated 5th June.

IRRIGATION BOARD'S AGENDA : SIMLA MEETING. June 9, 1937.

Gives briefly the agenda of the meeting of the Research Committee of the Central Board of Irrigation in June.

MARALA WEIR HEADWORKS : RS. 15½ LAKH SCHEME FOR REMODELLING. June 11, 1937.

See page 13 of Quarterly Bulletin No. 4.

MYSORE SURPLUS BUDGET : BIG INCREASE IN ELECTRIC POWER CONSUMPTION : DEWAN'S ADDRESS TO ASSEMBLY. June 15, 1937.

Refers to the increased consumption of electric power in the State and to the proposed building of a power station at Shimsa Falls.

WATERS OF THE INDUS. June 16, 1937.

Certain remarks on the recommendations of the Sub-Committee of the Central Board of Irrigation on "Distribution of the Waters of the Indus and its Tributaries" appointed by the Government of India, under the chairmanship of Mr. F. Anderson, C.I.E., Chief Engineer, U. P.

OUR CALCUTTA LETTER :AGITATION OVER DAMOODAR CANAL : PLEA FOR IMPARTIAL ENQUIRY. June 16, 1937.

Criticises and points out the dangers resulting from the embankment on the northern bank of the Damodar river in the Burdwan district. Gives the history of the embankment and suggests the ways in which it can be made to benefit the people. It is claimed by the people that there should be embankments on both the northern and southern banks as prior to the construction of the line of the E. I. Railway in 1850, but there should be a sufficient number of sluices in both the embankments as also in the railway line in order to allow flood water to pass unhampered. It is also said that even the construction of the Damodar canal has not been able to protect the people from floods. In connection with the canal it is pointed out that the heavy tax imposed on the people under the Rural Development Act will make the canal disadvantageous to the people instead of advantageous.

GEODETIC OPERATIONS IN 1936 : SURVEY OF INDIA'S ACTIVITIES : PARTY'S ADVENTURES ON ASSAM-BURMA FRONTIER. June 16, 1937.

Review of the Report of Geodetic Operations in the year 1936. The report, among other subjects, deals with the study of subsoil water levels. In this connection a very detailed survey has been made covering an area of about 3,000 sq. miles, and the end of a long ridge (Shahpur-Delhi ridge) buried below the silt, which extends to near Delhi, has been charted. The effects of this ridge on the water levels in the Indo-Gangetic Plain have been shown.

DISPUTE OVER SHARING OF TUNGABHADRA WATER : MADRAS GOVERNMENT TO AGREE TO A DRAW-OFF ON HYDERABAD SIDE : ARBITRATION PROPOSED. June 17, 1937.

As the Madras and Mysore Governments have come to an agreement, the former have written to the Hyderabad Government that they are disposed to agree to a draw-off by diversion of the canal on the Hyderabad side equivalent to that by the Kurnool-Cuddapah canal on the British side. But the Hyderabad State wishes to examine whether the Mysore Government have radically changed their claims. Hyderabad thinks it better to entrust the whole case to the Government of India instead of an arbitrator.

DRAINAGE IN SIND. June 17, 1937.

Refers to the investigations made into the question of movement of sub-soil water in Sind, particularly in the barrage area.

BAGHAR INUNDATION CANAL : COMBINED REGULATOR AND ESCAPE UNDER CONSTRUCTION. June 17, 1937.

See page 6 of Quarterly Bulletin No. 5.

DRAINAGE OF LAND IN GANGES BASIN : EFFECT OF 1934 BIHAR EARTHQUAKE : GENERAL SURVEY CONDUCTED BY EXPERT. June 17, 1937.

The results of the report of the engineer appointed to survey areas in north Bihar to see the effect of the last earthquake on the drainage problem in that area, are being examined by the Government and gradually given effect to.

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CENTRAL BOARD OF IRRIGATION : ANNUAL MEETING OF RESEARCH COMMITTEE. June 17, 1937.

Gives briefly the agenda of the meeting of the Research Committee in June.

ELECTRIFICATION AT MYSORE : PART COMPLETED. June 17, 1937.

The Pykara plant which has been connected with the Mettur station has been put into operation. (This plant is in the Madras Presidency and not in Mysore State.)

IRRIGATION IN SUKKUR : SIND GOVERNMENT'S SCHEME. June 17, 1937.

Estimates are stated to have been prepared for constructing some tube-wells for irrigation costing about Rs. 10,000 each. A tube-well will give a discharge of a cusec and a half, sufficient to deal with about a square mile of ground at a cost of approximately Rs. 12 per acre. Borings will shortly be made to test the water.

IRRIGATION RESEARCH IN INDIA : ENGINEERS TO MEET NEXT WEEK. JUNE 17, 1937.

Refers to the Research Committee meeting of the Central Board of Irrigation and gives agenda.

CANAL IRRIGATION RESEARCH · SIMLA .DISCUSSIONS. June 17, 1937.

Same as above.

VICEROY'S EXECUTIVE COUNCIL : RESHUFFLING OF DEPARTMENT. June 18, 1937.

Refers to the proposal to change the present two Departments of Commerce, and Industries and Labour, in the Government of India to three Departments of Commerce, Communications and Labour. Irrigation will come under Labour.

POPULATION AND FOOD PLANNING : OCCUPATIONAL MAL-ADJUSTMENT : INDIAN PROFESSOR'S LECTURE IN LONDON. June 19, 1937.

Lecture of Prof. Radhakamal Mukerjee before the London School of Economics.

CENTRAL BOARD OF IRRIGATION : ANNUAL MEETING OF RESEARCH COMMITTEE. June 19, 1937.

Gives the agenda and the names of the officers attending.

IRRIGATION AND THE SPREAD OF MALARIA : HEALTH OFFICERS' VIEWS : JUNE 19, 1937.

Refers to the pamphlet "Man-made Malaria in India" issued by the Public Health Commissioner, in which it is stated that prevalence of malaria is attributable to engineering works, particularly irrigation works. Also refers to Mr. T. B. Tate's note on the policy of irrigation in India published in the Annual Report for 1935-36 of the Central Board of Irrigation and says that although it was expected that the Board would suggest that engineers should get training in tropical hygiene, it has given a different reason for this malady, namely, the lack of sufficient provision in the estimates for irrigation projects to cover the cost of drainage along the canals.

MADRAS-TRAVANCORE ARBITRATION : NORTH INDIAN JUDGE TO BE UMPIRE. June 20, 1937.

It is now known that the arbitration on behalf of the Governments of Madras and Travancore in the dispute between the two Governments as to the right of the former to generate electric power from waters impounded by the Periyar Lake besides utilizing them as at present for irrigation, have chosen a North Indian High Court Judge as umpire to adjudicate the issues arising out of their different awards.

IRRIGATION IN BIHAR : POSSIBILITIES OF NEW SYSTEM. June 21, 1937.

The possibilities of mechanically operated tube-wells for purposes of irrigation on a wide scale in Bihar are being investigated by the local Government.

TUNGABHADRA PROJECT : IRRIGATION ENGINEERS TO CONFER. June 22, 1937.

To discuss the scheme the Chief Engineer, Hyderabad State will meet the Chief Engineer for Irrigation, Madras.

CENTRAL BOARD OF IRRIGATION : SEVENTH ANNUAL MEETING OF RESEARCH COMMITTEE : MR. G. M. ROSS' SPEECH. June 24, 1937.

Speech of the President of the Central Board of Irrigation opening the meeting of the Research Committee on June 21.

HOW MODELS CAN HELP : IRRIGATION PROBLEM. June 24, 1937.

Describes briefly the experiment being carried out in the Punjab Irrigation Research Institute with a model of the river upstream of the Islam Weir to ascertain how straight flow can be obtained between the guide banks of the river so that there may be no shoaling up, and 'pockets' may be kept clean.

BUDGET DEBATE IN PUNJAB ASSEMBLY. (Extract from ——). June 26, 1937.

The Revenue Minister stated that the Haveli Project has been launched and that every endeavour had been made to obtain expert advice and that as far as possible material available in the country would be utilized.

As for the Thal project he said that the scheme had been carefully considered but not yet submitted to the Government of India. It is expected to get sanction soon.

As for the Bhakra Dam scheme he explained numerous difficulties in the way, the most important being that of securing the co-operation of Bilaspur State, 171 villages of which will have to be submerged. It is said that if Bilaspur does not agree they had an alternative of sinking tube-wells, and a special officer has been deputed to study the working of the tube-well scheme in the United Provinces.

GIPD—L125 Secy. CBofIrr. Simla—5-8-37—1,100.

GOVERNMENT OF INDIA

CENTRAL BOARD OF IRRIGATION

QUARTERLY BULLETIN NO. 7.

JULY TO SEPTEMBER, 1937.

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SIMLA,
15TH OCTOBER, 1937.

Mr. C. C. Inglis, C.I.E., I.S.E.

Director
Central Hydrodynamic Research Station
Khadakwasla, near Poona

Office of the Secretary,

Central Board of Irrigation,

Simla, H. O.

QUARTERLY BULLETIN NO. 7.

JULY TO SEPTEMBER, 1937.

The Board.

As mentioned in the last Bulletin, the annual meeting of the Board will be held in Delhi from 30th October to 4th November. The President of the Board, Mr. G. M. Ross, C.I.E., will open the proceedings. The following are some of the subjects to be discussed at the meetings :—

(i) Research Reports presented by the various Provincial Research Officers at the last meeting of the Research Committee, together with Research Committee's conclusions on special subjects.

(ii) Discussion of the following subjects brought forward from last year :—

- (*a*) Means to secure the equitable distribution of irrigation water.
- (*b*) Design of weirs on permeable foundations.
- (*c*) Design of canal falls.
- (*d*) Waterlogging and land reclamation.
- (*e*) Staunching of canals.
- (*f*) Meandering of rivers.
- (*g*) The development of power from canals for domestic, commercial and agricultural purposes and for the extension of irrigation.
- (*h*) The fair incidence of the cost of irrigation water on different classes of crops.
- (*i*) The policy of irrigation in India, with special reference to future development and finance.
- (*j*) The design of channels in alluvium.

(iii) Consideration of the following new subjects :—

- (*a*) The role of reservoirs in river flood control.
- (*b*) Draft Questionnaire on Drainage Systems in Irrigated Areas.

The following administrative questions may also be discussed :—

(i) The question of appointing a successor to the present Secretary.

(ii) Inter-Provincial and inter-State development.

(iii) The advisability of separating irrigation from floods and river control.

(iv) Re-designation of the Board as the Central Board of Irrigation, Hydro-Electricity and Flood Control.

(v) Sir John Russell's recommendation for a Central Research Station for Irrigation.

2. The U. P. Govt. have invited the Board to visit the Chitaura Power Station on the 2nd of November on the occasion of the opening ceremony to be performed by His Excellency the Governor of U. P.

3. The Board may also visit the Imperial Agricultural Research Institute at Delhi.

4. The following changes in the Membership of the Board have taken place during the quarter : —

Mr. G. M. Ross, C.I.E., Chief Engineer, N.-W. F. P., and President of the Board, who had gone on leave in July last, has taken over from Mr. A. Oram with effect from the 1st of October.

Mr. C. C. Mackintosh, Chief Engineer, Burma, is returning from leave and will take over from Mr. A. A. H. Ricketts at the beginning of November.

Research Committee.

Conclusions of the Research Committee will be considered by the Board at the forthcoming annual meeting.

2. The informal winter meeting of the Research Officers will be held at Lahore at the time of the Punjab Engineering Congress, which generally takes place some time in February.

3. Dr. E. McKenzie-Taylor, Director, Punjab Irrigation Research Institute, is proceeding on leave in November.

4. The following are the provisional programmes of research for 1937-38 in the various Provincial Research Stations. (The programme of the Central Hydrodynamic Research Station at Khadakvasla has already been given in the last Bulletin on page 15).

United Provinces P. W. D. (I. B.) Research Section, Programme of Work for 1937-38.

The work of the Research Section will be mainly confined to the following groups of subjects :—

1. *Staunching of Canals and Guls.*—(*a*) The evidence of considerable loss occurring in a lined channel (*vide* page 6 Technical Memo. No. 6)

shows the necessity of further investigation in this direction. There are now various types of lining in existence in the Province and these will be tested for staunchness.

(*b*) The financial aspect of channel lining will be taken up again. Since the last attempt more data has been accumulated, and the modified losses through the lined portion will be taken into consideration. A definite reach of canal with its gul system will be analysed in full detail, and, as regards the gul system, account will be taken of the number of days the various branches run during the seasons.

(*c*) Experiments on channel lining will continue.

2. *Losses on Main Canals and Branches.*—(*a*) Examination of the statistics contained in Appendices F, and Distributary Statistics of the Supplements to the Irrigation Administration Report (Annual) will be undertaken for the Ganges Canal System to arrive at the volumes of water contributed to the tube well areas by canal seepage.

(*b*) Losses for Main Canals and Branches will be determined by field measurements if specific enquiries are received from Circles.

3. *Losses in Distributaries and Minors.*—Further losses will be determined mainly in connection with 1(*b*) and 2(*a*) above.

4. *Losses in Guls.*—Experiments on gul losses will continue and information as to the type of soil and clay content will be collected in each case.

5. *Silt Observations.*—Work under this head is largely dictated by the number of enquiries received from Divisions.

Records will continue to be kept of temperatures of canal water.

The silt load, which has received little attention to date, will be recorded on the Kheri Branch throughout the year.

6. *Silt Selective Heads.*—The various designs constructed in the field will be kept under observation.

7. *Model Work.*—The following cases will be examined :—

(*a*) Scour Below Bahadurabad Power House, Upper Ganges Canal.

(*b*) Scour D. S. of Karan Nadi Flume, Hathras Branch, Upper Ganges Canal.

(*c*) Scour below the Absara Syphon, Rohilkhand Canal Division, Sarda Canal.

(*d*) Protective Devices to cheapen the proposed Karan Nadi Fall.

(*e*) Silt Selective Heads. (This depends on the views expressed at the Meeting of Research Committee of the Central Board of Irrigation in June 1937.)

Other investigations depend on enquiries from Circles.

8. *Miscellaneous and Advisory.*—Work under this head depends on enquiries, but there are the following cases to be dealt with.

(*a*) Preparation of a Report on the Records required from the Tube Well Areas for future Statistical Work.

(*b*) Revision of the instructions contained in the Manual of Professional Orders on the observation of discharges in distributaries and minors. The large amount of data collected by the Research Section will be utilized for this purpose.

(*c*) Preparation of Standard Design for Flumed Sections.

IRRIGATION RESEARCH DIVISION POONA—BOMBAY.

Outline of work proposed during 1937-38.

I. *Effect of irrigation on different soil types.*

1. Soil types in the Deccan canal tracts and their behaviour under irrigation (to be continued).

2. Movement of irrigation water through various types of soils moisture gradients.

3. Losses of irrigation water by :—

(1) Transpiration.

(2) Evaporation.

(3) Percolation.

4. Relative rise of salts in soil from solutions of various strengths.

5. Classification of damaged areas.

II. *Reclamation.*

6. Laboratory and pot experiments under controlled conditions with a view to reduce the cost of reclamation.

(*a*) (1) Molasses (2) Calcium setts-increasing the concentration of calcium ions (3) Sulphur (4) Alum.

(*b*) Evolution of CO_2 from soil under various stages of reclamation.

(*c*) Fixing the dose of gypsum per acre for damage of various intensities.

Field Experiments.

7. Selection of cane varieties and other rotational crops suitable for growing during land reclamation.

8. Soil tilth experiments.

(i) F. Y. M. series.

(ii) Chemical treatments (Gypsum).

III. *Experimental work at the Effluent Research Station Hadapsar.*

(i) To ascertain whether it is necessary to discontinue effluent after cane is 10 months old.

(ii) The maximum dose of effluent that cane can withstand without reducing the outturn or deteriorating the quality of gul.

(iii) Whether it is essential to dilute effluent before applying to crops.

(iv) The effect of Fallow effluent treatment for soil before plantation of cane.

(v) Cane varieties suitable under effluent irrigation.

(vi) Cane varieties suitable for seasonal plantation.

(vii) Effect of effluent on various types of soils.

IV. *Miscellaneous.*

(i) Liquid mud.

(*ii*) Reducing losses in channels by sodiumising the sides.

PUNJAB IRRIGATION RESEARCH INSTITUTE

PROVISIONAL PROGRAMME OF WORK FOR 1938.

I. *Chemical Section.*

(1) *Movement of Salts and Moisture in Soils.*—The work proposed on this subject is in continuation of that already reported in the Annual Report for 1936-37. Particular attention will be paid to the effect of atmospheric humidity on the movement of salts and the moisture content of the soils. An intensive examination of a small area in the field will be made to determine the influence of the water-table and other factors on the movement.

(2) *Soils Mechanics.*—During the past year, considerable progress had been made in the experiments for preventing seepage losses. It has been found that a 4″ layer of soil treated with sodium carbonate is impermeable under a head of 13′. Chief Engineer has ordered that certain distributaries should be treated during the cold weather. These experiments will be carried out.

The effect of sodium carbonate treatment during the manufacture of bricks has also been under examination. Further experiments will be carried out to determine the effect of the treatment on the strength of the bricks and on their porosity. The increase in the strength of the bricks and the reduction in their porosity should have important applications.

A grant has been received from the Government of India for the study of earth roads. It is proposed to investigate the effect of the exchangeable bases on the soil properties, the methods for the control of salt movement and the part played by clay and other fractions in the soil in consolidation. Methods for testing the properties of the soil from the point of view of roads will be worked out.

(3) *Alkali Soils.*—Further investigations will be undertaken to determine the amount of gypsum required to prevent the deterioration of soils and also the quantities that must be used at various stages of deterioration to restore the soil to its original condition.

(4) *Methods for the Examination of Soils.*—An attempt will be made to develop methods for the rapid and accurate determination of the chemical and physical properties of soils.

II. *Physics Section.*

(1) *Seepage.*—Investigations will be continued to determine the relation between the seepage from the canal and the depth of the Water-table. Experiments on this subject are already in progress at Renala. In this connection a method is now being developed for the determination of the transmission co-efficient of fine materials using air instead of water.

(2) *Tube-Wells.*—In collaboration with the Officer on Special Duty, Tube-Well Investigations, a number of subjects have been drawn up for study in the Physics Section. Among these are the relation of discharge to the following :—

(*a*) Length of strainer.
(*b*) Position of strainer.
(*c*) Diameter of strainer.
(*d*) Draw down.
(*e*) Shrouding,
(*f*) Type of strata.

Experiments are already in progress on a number of these points. It is also hoped to carry out experiments in the field on the above subjects.

(3) *Pressure on Retaining Walls.*—The apparatus for determining pressure on retaining walls has been developed and investigations on this subject in model form will be carried out during the year. This subject is in continuation of the uplift pressures on weirs.

(4) *Defects under Weirs.*—This is in continuation of the programme for 1936-37. The apparatus for the transmission of ultra short waves has been perfected. It is hoped during the year to complete the construction of the receiving apparatus and to carry out tests so as to perfect the method for field use.

(5) *Soil Mechanics.*—This subject is being developed in connection with angle of repose and erosion. Experiments are to be carried out to study the effect of clay and other fine materials on cohesion and on other factors which determine erosion.

III. *Mathematical Section.*

(1) *Movement of Silt and the Regime of Channels.*—The data which has been collected during the past four years is now under examination and it is hoped to derive relationships which will express the effect of silt

on regime. When these relationships have been formulated it is proposed to test them out at further sites which will be established and some of the present sites abandoned.

(2) *Experiments on the Models of the Rivers and Works in connection with the Haveli Project.*—A model of the rivers Chenab and Jhelum above and below their confluence has been constructed and the following are to be examined :—

(*a*) The position and size of the bunds necessary during construction period.

(*b*) The position, length and form of the guide banks that would be necessary.

(*c*) The position of the leading cuts to divert the river on to the weir.

(*d*) The effect of the weir on the river and the training works that would be necessary for river control.

A model of the weir, left undersluices and canal regulators has been constructed for the examination of the best form of silt excluder and for the scour downstream. A model has also been constructed to determine the effect of the groynes on the scour downstream and the afflux upstream. An investigation will also be carried out regarding the designs of the silt ejectors in the canals.

IV. *Statistical Section.*

(1) *Studies in Subsoil Flow under Irrigation Works.*—The following theoretical investigations connected with the problem of weir design will be carried out in continuation of the work of 1936-37 :—

(*a*) An examination of Lane's 'weighted-creep' theory.

(*b*) Subsoil flow under a depressed floor.

(*c*) Pressure distribution under a floor with equal end piles and a changing intermediate pile—An empirical extension of Khosla's Principle of Independent Variables.

(*d*) The role of corners in irrigation structures—floors with and without corners.

(*e*) A review of the hydraulic model experiments from the standpoint of streamline theory.

(*f*) Subsoil flow with equal piles at heel and toe of a flush floor.

(*g*) The comparison of thick cut-offs like well-lines or curtain walls with thin cut-off like steel piling.

(*h*) Effect of uniform downstream or upstream scour on flow under a depressed floor.

(*i*) The design of sloping floors with reference to uplift pressure.

(*j*) The flow under a depressed floor fitted with equal end piles.

(*k*) The flow under a flush floor fitted with unequal end piles.

(*l*) The flow under a depressed floor fitted with a central pile.

(2) *Rainfall—Run-off Studies.*—The relation between the winter supplies in rivers and the date of the stoppage of monsoon in the catchment will be investigated to trace the probable effect of the increase of denudation in the foot-hills.

(3) *Silt Problems.*—It is hoped to examine the effect of temperature on silt movement in stable channels under regular observation, and of the regulation at headworks on the silt entry into canals.

(4) *A Study of Salt-afflicted Villages.*—The conditions in a number of villages afflicted by salts will be studied and the factors influencing the extent of area irrigated each year will be analysed. This is in continuation of work already in progress.

V. *Hydraulic Section.*

It is difficult to give a definite programme of work in the Hydraulic Section as this is determined by the models required by the Chief Engineer. The work to be continued consists of the examination of the Trimmu Weir Models in connection with the design of the weir and its protection downstream Orders have also been received for the examination of the conditions of the working of the undersluices of the Rasul Weir. The Falls at Pakpattan Canal are also to be examined so as to provide protection against scour downstream and bank erosion.

The examination of the River Sutlej at Islam will be continued with the object of determining the training works necessary to prevent bela formation between the guide banks. It is also proposed to examine a model of the river Chenab at Khanki to determine—

(*a*) the supplies in various parts of the river that will result in the minimum silt entry into the canal in summer and winter.

(*b*) the regulation of the undersluices which will result in the optimum silt distribution.

(*c*) the effect of the method of regulation on bela formation upstream.

(*d*) the methods to be adopted to obtain the greatest advantage in undersluices in Bay 4 of the weir.

VI. *Land Reclamation Section.*

(1) *Reclamation of Thur Land.*—(*a*) Observations on the crops obtained from reclaimed 'thur' land indicate that if a proper rotation of crops is adopted after reclamation there is no decline in yield. These observations will be continued in 188 N. B. Lower Jhelum Canal.

(*b*) A fresh experiment on the reclamation of 'Thur' land belonging to R. B. Sardar Basakha Singh in Lower Bari Doab Colony has been sanctioned by the Chief Engineer. This will be started during the year.

(2) *Prevention of Land Deterioration.*—(*a*) The experiments already in progress at Kot Ranjit, Chak 7, and Garjakh in the Upper Chenab Canal area will be continued.

(*b*) With the approval of the Chief Engineer an experiment in this respect, is being started by Raja Narendra Nath under the direction of the Institute. It is proposed to make a survey of fields which have begun to give low yields of wheat. These will be treated with gypsum on the basis of their calcium deficiencies and the effect on the yields of wheat studied.

(3) *Soils Surveys.*—(*a*) *Surveys by means of Aerial Photographs.*—Some preliminary work in the possibility of using aerial photographs for classifying the various types of soils in cultivated areas was done during the previous year. It is hoped to utilize these photographs for making a soil survey of project areas for colonisation and settlement purposes. Investigations may also be carried out on the other uses to which these photographs can be put. Calculations show that a survey by means of aerial photographs is much cheaper than that done by the field staff on the ground.

(*b*) An intensive study of the Sem and Thur conditions of 14 villages in the Sheikhupura District has been undertaken in co-operation with the Statistical Section. This will be continued.

(*c*) Twenty-five villages situated on two lines across the Rechna Doab with varying water-table depths have been selected. It is proposed to submit them to Special Thur Girdawries every five years and study the rate of the deterioration of land on the basis of an efflorescence at the soil surface in the winter months.

(*d*) For determining the effect of the Deg Diversion in the Upper Chenab Canal Area, 24 villages situated on either side of the abandoned Main Line Lower have been kept under observation. A survey will be made every five years.

(*e*) Before the commencement of irrigation in the Lower Bari Doab Colony a soil survey of certain portions of it was done. It is proposed to select certain villages in the head reach and make a further survey to compare the condition of the land now when the water-table has risen with that at the commencement of irrigation.

(*f*) In co-operation with the Settlement Officer a history of the development of Kallar in certain villages in the Amritsar District is being worked out from the Patwari's records.

(4) *The Distribution of Salts and Moisture in the Soil Profiles under Irrigation.*—(*a*) Profiles have been exposed to the water-table in the Rechna Doab and the Bari Doab and their examination has thrown considerable light on the effect of irrigation on the movement of salts and moisture in the soil. From the data obtained it is possible to identify soils which are likely to deteriorate early and those which are likely to deteriorate late.

It is proposed to continue this study and examine profiles from some other areas.

(*b*) An area near Jaranwala has been acquired and the land has been divided into blocks. Each block is put under a different system of cropping. The distribution of salts and moisture in the soil is studied after every crop. The water-table in this area is rising. It is hoped to obtain from this experiment information on the type of cropping which would prevent the appearance of 'Thur' at the surface. This work will be continued.

(*c*) Samples of soil are being taken twice a year from some plots selected for experiments on the prevention of land deterioration. It is proposed to carry this over a period of years. From this it will be possible to work out the variation in the salt content and pH value from year to year.

(5) *Study of Soil Profiles with reference to their Natural Flora.*—So far, this study has been confined to the soils and the natural flora of west Punjab. It is proposed to undertake a similar study of the unirrigated tracts of the south eastern portions of the Province.

(6) *The Rise of Water-table in the Rechna Doab.*—Water is rising rapidly in the Lyallpur District. Difference of opinion exists as to the cause of this rise and the source of this water. It is proposed to investigate the following :—

(*a*) Is the water being transferred from the upper portions of the Doab through a deep coarse sand layer? If so, what is the rate of this transmission?

(*b*) Is the pressure gradient the main factor responsible for the rise of water-table in the Lyallpur area?

(*c*) Is seepage from canals in the area an important factor?

In addition it is hoped to re-examine the water-table records of the upper portion of the Rechna Doab to determine whether they are registering true water-table or only the pressure gradient.

(7) *The Determination of Soil Erosion and Run-off Intensity.*—Experiments on this subject have been in progress at Madhopur in land with slope 1 in 4. These will be continued. In co-operation with the Research Officer, Forest Department, a second site near Nurpur has been equipped with the necessary apparatus and measurements have been started. These will also be continued.

(8) *Measurement of Run-off in the Catchment Areas of Drains.*—No information exists regarding run-off in areas where surface drainage is necessary to prevent the rise of the subsoil water. In the absence of this information it is difficult to fix the capacity of the drains. Experiments have been started in three areas in the Rechna Doab to determine run-off. On account of the failure of the monsoon it seems it may not be possible to obtain enough data this year. It is proposed to carry out the experiments again next year.

(9) *Tube Well Irrigation.*—At the request of the Officer on Special Duty, Tube-well Investigations, an intensive study of the present practice of well irrigation in various parts of the province and the probable changes in cropping intensity that would result if tube well irrigation is introduced has been started.

VII. *General Section.*

(1) *Examination of Soils from Waterlogged Areas in the Canal Irrigated Parts of the Punjab.*

(2) *The Study of the Fundamental Properties of Soils.*

SIND.

Programme of work in the Development and Research Division, Karachi, for the year ending May 1938.

It is proposed to carry out the following work during the current year :—

(i) Model experiments.

(ii) Further experiments in connection with Back water effects, if found practicable.

(iii) Further investigation into methods of silt sampling and the investigation to determine a method of calculating the quantity of silt entering a channel.

(iv) Examination and correlation of Hydraulic data and silt analysis.

(v) Collection of Hydraulic data on Rohri Canal and its off-takes, with a view to find out Lacey's silt factor for the Rohri Canal System.

(vi) Investigations into the movements of sub-soil water-table in Sind.

(vii) Determination of areas (from salinity contour plans) which are likely to have been affected by the rise of salt to the surface due to the rise in sub-soil water-table having a high salt content; and reclassification of such lands to see the extent of deterioration, if any.

(viii) Experiments to determine the absorption and evaporation losses passing through different soils in Sind.

(ix) Usual Laboratory work.

Board Publications.

1. Revised edition of "Glossary" (Pubn. No. 5) is still under preparation as replies from some officers are still awaited.

2. "Design of Weirs on Permeable Foundations" (Pubn. No. 12) is still in the press but is expected to be issued shortly.

3. The question of publishing Mr. P. Claxton's Note on "Silt Load on the Behaviour of Rivers" as a Board Publication will be considered by the Board at the forthcoming meeting.

4. The question of publishing Mr. C. C. Inglis' report on his experiments with the design of falls as a Board Publication will also be considered at the forthcoming meeting of the Board, if the report is ready by that date.

5. The recommendation of the Research Committee that the U. P. Govt. should be asked to place Mr. Gerald Lacey on special duty to write a publication on the Design of Channels in Alluvium will be considered by the Board at the annual meeting.

6. The Annual Report (Administrative) of the Work of the Board for 1936-37 (Pubn. No. 15) was distributed to Members of the Board and others concerned.

Works Section.

MADRAS.

Drainage Outlet at the Mouth of the Mangalavani Chinka at its Outfall into the Puligedda Arm of the Kistna River.

The Kistna left flood bank crosses at 45/1 the Mangalavani Chinka, (a drain with a catchment of 16·5 sq. miles) at its outfall into the Puligedda arm of the Kistna river. At this crossing, a reinforced concrete outlet sluice with automatic flap shutters to keep out river floods, has been built.

The outlet consists of 8 bays 6′ to 10′ wide with three counterforts (or piers) 2′ thick and four others 1′ thick and 17·7′ high. R. C. breastwalls are provided in the bays down to the lintel slabs in the two central bays, and to the bed slab in the other bays. The bed slab 15″ thick is rigidly tied to the eight twin octagonal wells (8′ outer and 5′ inner diameters) on which it rests. The pressure on the bed slab is not uniform, as the two central bays have to bear water pressure, while the other bays have only earth pressure. The bed slab has therefore been designed as three units with 2 butt joints connected by bent copper strips to form a flexible joint. These joints are carried right through to the top of the breastwall. A roadway 8′ wide between kerbs is provided on the top. Abutments and wings have been avoided as the structure projects well into the bank. Its total length is 78′.

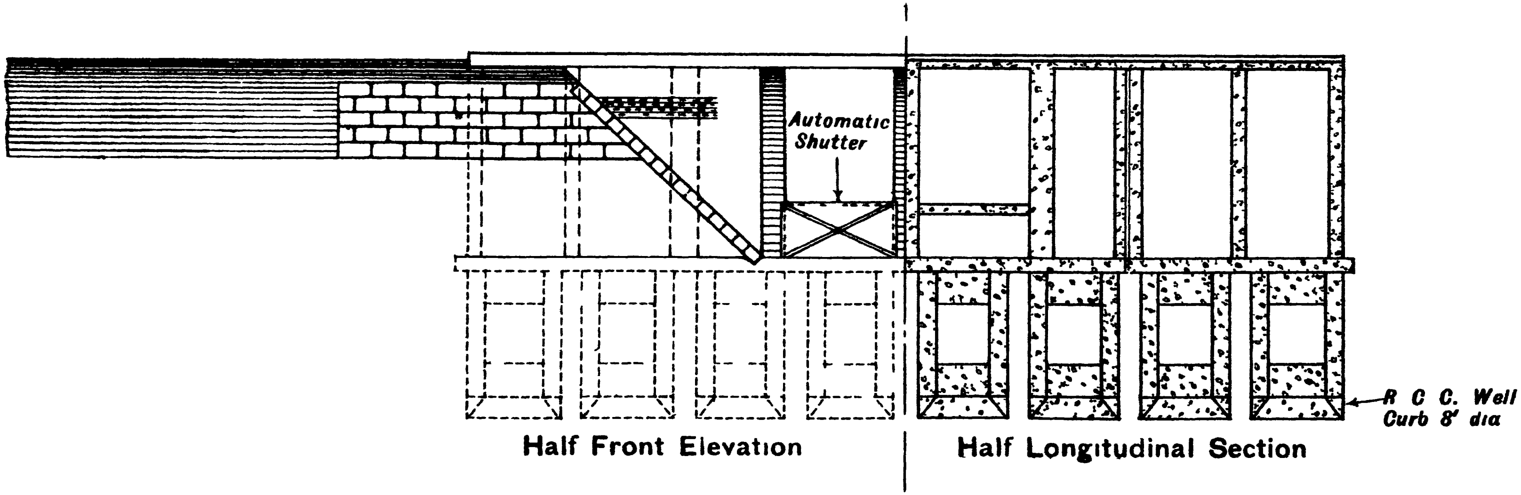
The factors that weighed in the adopton of a reinforced concrete design are (1) comparative cheapness, (2) the short period available for work and (3) availability of a competent contractor skilled in reinforced concrete work.

Estimated cost of the work is Rs. 37,500.

The design of the Outlet is shown on the adjoining page.

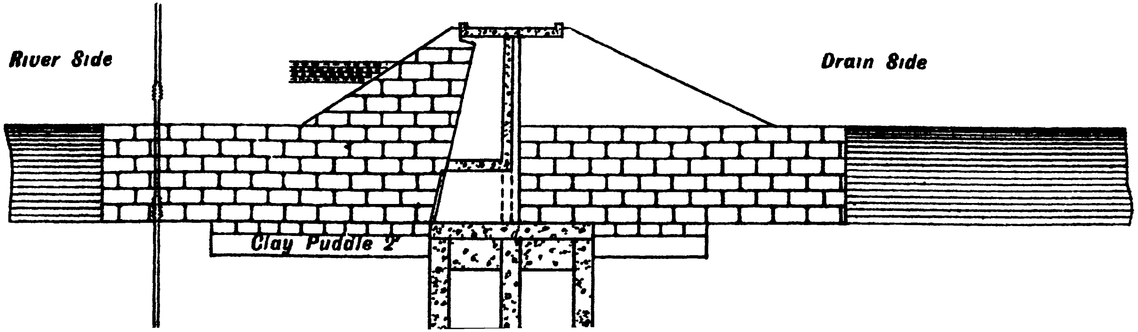
Campbell Aqueduct across the Puligedda Arm of the Kistna river.

DESIGN for a DRAINAGE OUTLET at the MOUTH of MANGALAVANI CHINKU at $\frac{45}{1}$ of KISTNA LEFT FLOOD BANK

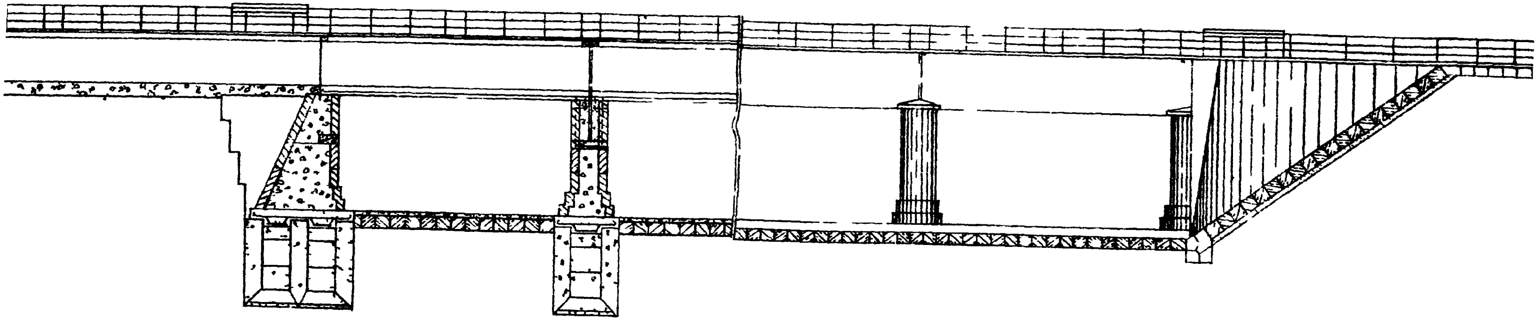


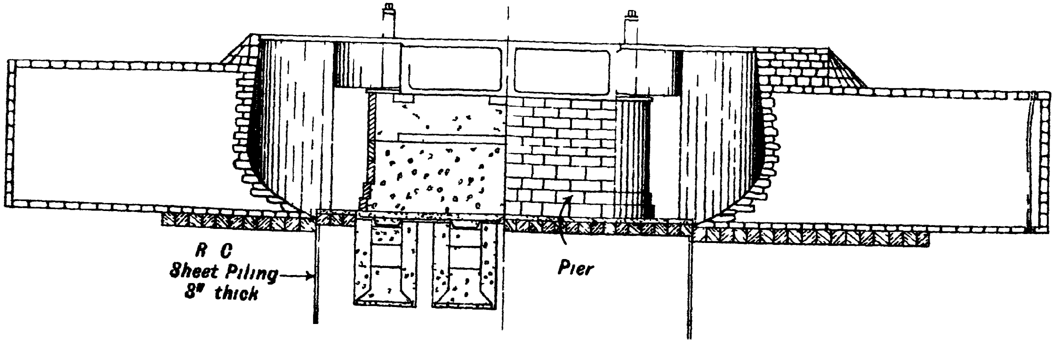
Half Front Elevation

Half Longitudinal Section



DESIGN for the AQUEDUCT
ACROSS the PULIGADDA ARM of the KISTNA RIVER (36 spans of 30')





42,000 acres in Divi Island were hitherto irrigated by a system of channels fed by water pumped from the Kistna river. Pumping has now been replaced by direct flow. An irrigation canal has been taken from the mainland to the Divi Island across the Puligedda Arm of the Kistna river by means of a submersible aqueduct which functions as a bridge as well. The aqueduct which is of reinforced concrete consists of two troughs 12′—0″ wide and 5′—6″ deep, carried on piers 4′—6″ thick. It carries a discharge of 615 cusecs, and has four vents for surplusing excess water, two at each end. The downstream trough is covered by an R. C. slab and carries a road 16′ wide. The foundations are protected against possible scour with R. C. piles on the up and down stream sides. The special features of the design are (1) the sides of the trough function as beams with special rigid end connection, effecting economy in cost and reducing obstruction to the passage of river floods, (2) special reinforcement has been provided for the bottom slab as well as for all the beams at the top, and the bottom slab has been anchored down to the piers by special holding-down bolts as the trough is liable to submersion in floods, and (3) provision is made for watertight expansion and contraction joints. On the rare occasions when the structure is overtopped by floods traffic over the roadway will be temporarily stopped.

Total length of the aqueduct is 1,332 ft. It has 36 spans of 30 ft. each. Cost of the work is Rs. 7,45,000.

The design of the aqueduct is shown on the adjoining page.

BENGAL.

Re-conditioning of the Anderson Weir, Damodar Canal.

The following two interesting works executed in connection with the re-conditioning of the weir are described :—

1. *Franki sheet piles.*—The Anderson Weir over the Damodar river at Rondia was damaged considerably in the year 1935. There occurred an abnormal flood in the Damodar river on the 12th August 1935, and after the subsidence of the flood it was detected that in addition to other damage caused to the Headworks, cracks had developed in the downstream glacis of the Weir. Two lines of sheet piles were driven on the upstream and downstream sides of the Anderson Weir. Franki sheet piles were driven on the downstream side of the Weir, the Under-sluices and the Head Regulator. This is shown in the sketch on the adjoining page. Altogether 67,247 sq. ft. of reinforced Franki sheet piles (at a cost of Rs. 1,71,000) were used, the sheet piles being 15 ft. in height. The piles were reinforced with ½″ diameter M. S. rods placed vertically at centres of 6″ approximately (5 Nos. in a length of 2′—7″). ¼″ diameter rods were used horizontally at 12″ spacing, and the piles were also stiffened diagonally. The proportion of the concrete used was 6 :4 :1 ·25.

2. *Guniting the Anderson Weir Wall.*—The Anderson Weir wall is made of mass concrete. The surface of the Weir became rough and it was decided that ½″ thick cement plaster be applied to the Weir wall by the Gunite process. The total area treated by the process is 65,874 sq. ft. at a cost of Rs. 15,204. A 3 :1 mixture was applied under air pressure of 15 to 20 lbs. per sq. inch.

BOMBAY.

Improvements to Phaltan Sangvi Road.

Between Phaltan and Sangvi where communication is necessary between Phaltan and Baramati, it is proposed to join the irrigation tracts of Nira Right Bank Canal and Nira Left Bank Canal. The junction is to be effected by bridging the Nira river and improving the existing road between the two places. The existing road is impassable for the greater part of the year and it is desirable to facilitate the traffic between the two places. The designs of the bridge, road and drainage works are in hand.

BURMA.

Nwadet Link Canal and Auxiliary Works.

The Burmans threw weirs across rivers to feed their canals exactly as we do now, but they were not experts at masonry works and so left the heads of their canals open. The Zawgyi river in the Kyaukse district was dammed up in this way and in course of time the open headed canal enlarged till eventually it took practically the whole of the normal discharge of the river, the small amount escaping into the original bed being used some distance downstream to irrigate what is now known as the Nwadet and Kunze branch canals.

With the annexation of Upper Burma the original Zawgyi river was mistaken for a canal which was named the Nwadet canal and a regulator was constructed where the Burmese weir existed, the Zawgyi continuing to flow down the enlarged Burmese canal. Since then considerable damage has been done to the Nwadet Canal in years of exceptional flood, since all excess water finds its way along what is obviously its natural drainage line.

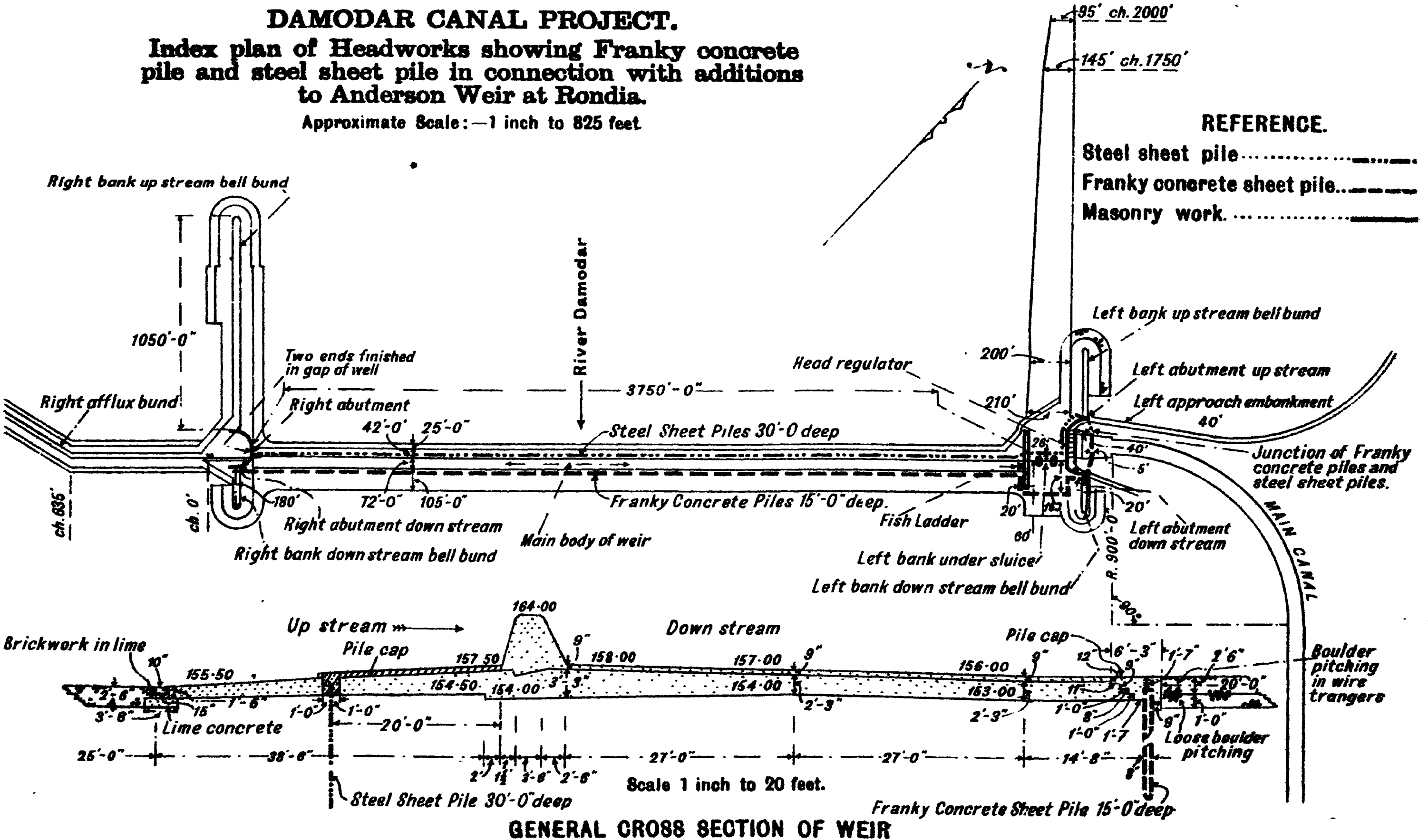
The Nwadet Canal has now been abandoned and the Nwadet and Kunze branch canals are linked up to the Zawgyi river lower down its existing course from above the Ngapyaung weir. The following is a description of the work recently completed.

"The Nwadet Link Canal takes off from the Zawgyi river 500′ upstream of the Ngapyaung weir and after cutting through a table-land of Hard Pan where the average depth of cut was 18′, it turns 85° to the right, keeping this table land as its right bank for the next 6,000 feet. After this the alignment climbs on to the watershed and in a single straight line makes for the Bifurcation of the Nwadet and Kunze Branch Canals.

DAMODAR CANAL PROJECT.

Index plan of Headworks showing Franky concrete pile and steel sheet pile in connection with additions to Anderson Weir at Rondia.

Approximate Scale:—1 inch to 825 feet



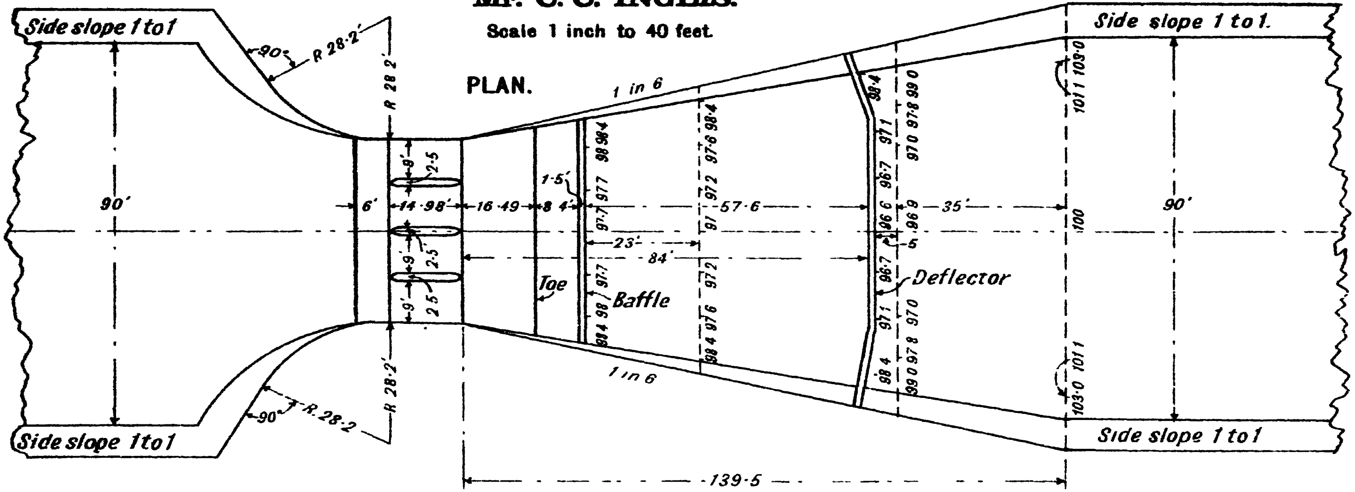
GENERAL CROSS SECTION OF WEIR

Army Section, No. 6 D.O., S. of I., No. 8985, 10.37.

DESIGN OF A FALL
supplied by
Mr. C. C. INGLIS.

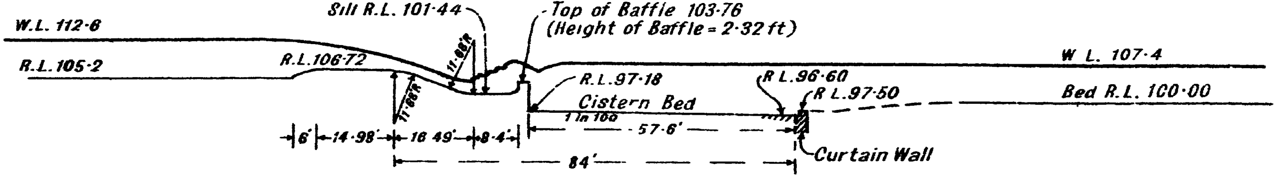
Scale 1 inch to 40 feet.

PLAN.



F. S. Q. = 1630 cusecs.
Bed width of Channel = 90 ft.
F. S. Depth = 7·4 ft.
H – difference of water levels
u/s and d/s = 5·2 ft.

LONGITUDINAL SECTION.



Army Section, No. 6 D.O., S. of I. No. 8985, 10.37.

Masonry works on this Link Canal comprise five falls, five bridges, a distributary head sluice and the Head Regulator of the Main Canal. This Head Regulator was designed with its axis making an angle of 60° to the axis of the river with a view to reducing the induction of silt into the canal. Of the falls three have raised crests, while the other two are flumed falls with Inglis baffles, and are combined with bridges. (A design for a canal fall recently prepared by Mr. C. C. Inglis, C.I.E., is published in this Bulletin).

The existing long and unwieldy Linzin Distributary was split into two lengths. The upper half now being fed by a short length of channels which takes off directly from the river but whose Head Regulator is combined with the Head Regulator of the Main Canal in such a way that the independent control of water to either channel is provided for. The lower half of the old distributary will be supplied with water from the Main Canal at a point three miles lower down by a channel 2,600 feet long.

The Nwadet Link Canal and auxiliary works will be completed by the 20th August 1937."

Information Bureau and Library.

As mentioned in the last Bulletin, the Library was kept open up to 7-30 P.M. throughout the summer season, but few officers have taken advantage of this arrangement.

2. The following are some of the enquiries dealt with during the quarter :—

River training.

Water lifting arrangements.

Library science.

Seepage and its measurement and prevention.

Watercourse outlets.

Design of foundations for buildings.

MISCELLANEOUS.

1. The following is an extract from Sir John Russell's "Report on the work of the Imperial Council of Agricultural Research in Applying Science to Crop Production in India" :—

"An All-India Irrigation Research Station".

The development of irrigation is one of the most remarkable features of modern India. Three sources of water are used :—

(1) canals from the great rivers—either snow fed rivers, or rain fed, and therefore requiring storage arrangements;

(2) wells from the underground supplies in the plains;

(3) tanks filled by rain or streams trained down into them.

The area now irrigated is very large. Out of 227 million acres sown in British India in 1934-35, 50·5 million were irrigated; practically half (26 million acres) from canals, and one quarter (12·5 million acres) from wells; further schemes are being discussed. A striking development is the combination of irrigation works with the generation of electricity which promises to effect marked changes in the life of the larger villages and smaller town.[*]

The supplying of water to the cultivator is the business of the irrigation engineer, and is usually well done in India. Two of the large provinces where irrigation is important, the Punjab and Bombay,[†] have Research organisations and other provinces have Research Officers who, however, are not infrequently charged with other duties also.

But the supplying of the water is only a part of the problem. A much more difficult matter is to use it advantageously so as to ensure permanent benefit to the district, and repayment of the heavy capital costs. When a great dam or barrage has been opened with much ceremony and flourish of trumpets it must always be remembered that the problems still remaining are greater than those already overcome because they are more continuous, more subtle, and much less under the control of the experimenter.

Three great groups of agricultural problems arise.

(1) Selection or if necessary production of new varieties of crops suited to the new conditions. New selections and hybrids are produced in many parts of India and interchange should be freely arranged between the various staffs concerned. The final selection must necessarily be made in the region where the crop is to be grown.

(2) The designing of the new cropping schemes. Usually the water supply is not entirely continuous but more is available at some seasons than at others. The cropping has to be so arranged that the best use can be made of the water and of the man and bullock labour available. Much more attention should be paid to this troublesome problem of arranging a sequence of crops at once profitable to the grower and permitting the best use to be made of the water. The potential improvement is shown by the fact that even now some cultivators succeed in making the water go much further than others : some of the Punjab sequences are admirable : while some of the larger cultivators have worked out methods that deserve detailed study and trial elsewhere.

In canal irrigation the water must be taken when it is given and the cropping scheme adjusted to the supply available. In planning a new canal irrigation project, therefore, the proposed cropping scheme should be as fully and as carefully considered as the engineering details.

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[*] The Meerut tube well scheme under the supervision of Sir William Stampe is a notable example of a well planned effort to combine water supply with electricity and with such amenities as bathing and washing facilities.

[†] Irrigation is chiefly by canals in the Punjab and from tanks in Bombay. The Bombay schemes are largely concerned with prevention of famine.

Where the water is supplied from tube wells greater control of the supply on the individual farms is possible, and therefore greater flexibility in the cropping scheme. Another set of problem then arises : the best times to supply the water to each crop and the optimum quantities to give.

These problems are fairly straightforward and present no special peculiarity.

The soil problems, however, are much more difficult, especially in regions of canal irrigation. Waterlogging and neutral salts can be dealt with, though the treatment may be very costly, but behind every large irrigation scheme there lurks the spectre of the alkali problems, for which in its final stages no economic solution has yet been found. Well designed experiments would no doubt suggest methods of dealing with the incipient stages when action is possible, and these should certainly be undertaken as early as possible. Constant watch should also be maintained to ascertain whether the salted and waterlogged areas are increasing or decreasing. Photographic aerial surveys would probably be the speediest and most effective means of doing this.

It may be laid down as an absolute rule that no irrigation scheme should ever be carried out until a proper soil survey of the region has been made. Areas containing salt or liable to serious waterlogging should only be brought into the scheme after consideration. This may necessitate a survey of the floor of the region, as described on page 128. A good preliminary survey reduces the risk of trouble to a minimum : but it is always there and on some of the existing schemes it is considerable.

All the various problems concerned are being studied at some or other of the Research Institutions, but the work is scattered, it is uneven in quality and in scale, and it lacks unified direction. I strongly recommend the stablishment of a Central Irrigation Research Station to undertake investigations on all agricultural problems associated with irrigation, and to supervise or be closely linked up with other irrigation investigations supported by the Council. The Station must be situated in the heart of a large irrigated area : the Punjab or Sind are obvious possibilities, probably the Punjab would be better as it could there be closely associated with the existing Institution at Lahore and with the college at Lyallpur.

But I cannot too strongly emphasise the difficulty of the work and the necessity for choosing the staff solely on the ground of their ability to do it. Suitable men are extremely scarce, and any restriction on the choice is likely to prove fatal to the scheme.

The Lahore Institute would remain as at present the centre for engineering research. It is so well staffed that it could probably widen its scope and undertake research on the surfacing of earth roads in rural districts, a subject which is not so remote from its present work as might at first sight appear. I suggest that the Council consider the advisability of discussing this possibility with the Irrigation Department."

2. The following are some items of interest in the Punjab :—

(i) Work on a few experimental tube wells is in progress; from these it is intended to obtain information on which the future of tube well irrigation in the Province may be judged.

(ii) Progress continues with the drainage systems for the northern part of the Punjab irrigated area. It is hoped that these drains will materially assist in stabilising the rising subsoil water table.

Experiments in connection with the staunching of channels on an increasingly larger scale continue to be made with the object of obtaining final and conclusive evidence of the value of the sodium carbonate treatment.

(iii) In Northern Punjab the Monsoon has been very meagre and river discharges lower than usual. The reconstructed Marala Weir has functioned satisfactorily though it has not yet been very highly stressed this summer.

(iv) Water surface slopes are being observed on the Western Jumna Upper Main Line and Lower Main Line to watch the effect of silt exclusion at Dadupur on the bed and water surface slopes of the Canal below Dadupur. Similar data is being collected on the Upper Bari Doab Canal in view of the construction of a silt excluder at its head in the next winter.

(v) Experiments were made at the Malikpur testing station on the Upper Bari Doab Canal to arrive at the width of cantilever slab required to keep shingle out of the canal. The slab will be constructed during next winter.

(vi) Work will be commenced shortly on the construction of a link canal, capacity 700 cusecs, from the Lower Bari Doab Canal near Montgomery to the Pakpattan Canal. This link canal will enable water set free in the Ravi by the Haveli Canals Project to be utilized in the Nili Bar Colony of the Sutlej Valley.

(vii) It has been decided to put a line of sheet piles below Islam Weir, and the work, which will cost about Rs. 3½ lakhs, will be carried out this winter.

(viii) Very interesting experiments have been carried out at Malikpur to study the layout of Guide Banks and arrangements for Diversion Cuts for the proposed Trimmu Headworks. The results obtained from the model are considered to be very satisfactory indeed; details of the experiments and the results achieved will issue in a separate publication. Further experiments at Malikpur are in progress to study the effectiveness of various devices for excluding silt from entering canal heads.

(ix) Work on the Trimmu Headworks has been commenced. The canal Railway line from Mudduki to the Station areas has already been laid. Tenders for Trimmu Barrage gates were received from eight firms. The contract has been given to the Public Works Department Central Workshops at Amritsar. Tenders for opening a new Quarry at Sikhanwala to supply stone for the Haveli Project have been accepted.

(x) The second circle of the Haveli Project has also been opened with K. B. M. Iqbal Hussain as the Superintending Engineer. The work in this Circle will mostly comprise of remodelling of the existing Canals of the Sidhnai and Chenab Inundation series.

(xi) The Thal Canal Project is still under further investigation.

3. The U. P. Weeekly Progress Report on Research mentions the following items of interest :—

(i) The Bulandshahr Power House Model Experiments for determination of scour have been finished and the report is under preparation.

(ii) Draw-down curves for certain tube wells for determination of transmission coefficient are under preparation.

(iii) The preparation of the modified Etcheverry instructions for the design of flumed structures using constants determined by discharge observations on the Karon Nadi Flume is in hand.

(iv) A Jesson type of metering flume has been constructed on the Dehra Distributary, Ganges Canal, in accordance with U. P. Design No. 272 R. D. 2, given in U. P. Technical Memorandum No. 6, and it is stated that the weir metered perfectly with as low a loss of head as 0·15 ft., the depth of the water over the crest being 1·4 ft. It is now proposed to construct a similar flume on the Mat Branch to deal with a maximum discharge of 1710 cusecs.

(v) Rehbock sills have been fitted to the new falls on the Kheri Branch.

4. In the United Provinces plots of light usar in the lower portions of the Sarda Canal are being reclaimed in conjunction with the Agricultural Department. To date, approximately 400 acres have been taken up. The process consists of sowing sun hemp with canal water in May and afterwards ploughing in and sowing a salt resisting rice. Water is given free to land owners for two years to encourage them to break up their light usar land, and the results to date appear promising.

5. It has been learnt from the Director of Irrigation, Ceylon, that they have adopted the Lacey Formulas for designing and remodelling channels in Ceylon.

6. The lower reach of the Tisza river in Hungary has been reduced in length from 700 to 435 miles—38 per cent—by 112 cut-offs. (For further particulars see the "literature" section).

7. Mr. M. R. Richardson, Chief Engineer, U. P., Mr. J. D. H. Bedford, Chief Engineer, Punjab, and Mr. A. Gordon, Chief Engineer, Sind, will represent the Board at the next meeting of the Crops and Soils Wing of the Board of Agriculture and Animal Husbandry in India, to be held at Lahore in December 1937.

8. Mr. C. G. Barber, C.I.E., M.B.E., Officiating Superintending Engineer, P. W. D., Madras, who was on leave in England, attended the annual meeting of the Executive Council of the International Commission on Large Dams held in Paris on 28th June 1937 as a delegate of the Central Board of Irrigation. Mr. C. B. Pooley, C.I.E., the honorary representative of the Board in England also attended.

9. Mr. R. T. Harrison, formerly Chief Engineer in Bombay, was invested with the insignia of the C. S. I. by His Majesty the King at Buckingham Palace on the 13th October, eight years after it was awarded. Mr. Harrison has been in Jamaica since he retired.

Literature.

The following literature was received during the quarter.

Readers are reminded that they are at liberty to borrow any of the literature in the Board's library, in accordance with the rules published in Bulletin No. 3, and to submit enquiries on any matter dealing with irrigation and allied subjects.

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CIVIL ENGINEERING AND PUBLIC WORKS REVIEW.

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UNDERGROUND WATER SUPPLIES.

At the forty-second general meeting of the Institution of Water Engineers, the President made some remarks regarding the urgent need of restricting the unscrupulous exploitation of underground water resources in Great Britain. As the law stands, it is open to any property owner to sink any number of wells in the near vicinity of the works of a water undertaker and by abstracting water without limit for his own purposes, to cause shortage in the public water supply without the water undertaker having any redress. The result of this indiscriminate exploitation of underground water is evidenced by a steady drop in water level which is taking place in a number of artesian and semi-artesian basins, which is giving cause for serious alarm. A restriction of the quantity of water pumped out is becoming increasingly necessary.

FOREIGN NOTES.

BRIDGES ON GERMAN MOTOR ROADS.

Two German bridges are briefly described. One of them is a reinforced concrete girder bridge of the continuous type, having 3 spans of 72 ft. 97 ft. and 72 ft. respectively. The girders are 2·5 ft. thick and their underside is curved.

The second bridge consists of a reinforced concrete deck carried on cross girders which rest on solid spandrel arches. There is no bracing between the spandrels and the structure has a light appearance. The spandrel arches are 2·1 ft. thick and at 19·7 ft. centres. There are five spans varying from 82 ft. to 92 ft.

A DIFFICULT SHEET PILE FOUNDATION.

The construction of the right bank pier of a bridge over the Rhine at Duisburg is briefly described. The pier was constructed within a sheet pile cofferdam. The interlocking piles were of 32—38 ton steel, 56 ft. long and were driven to 50 ft. below mean water level, the bottom of the foundation excavation being 40 ft. below mean water level. A 4 ton steam hammer with a stroke of 4 ft. was used and the minimum penetration per blow was ·02 in., some piles requiring 5000 blows.

LAND RECLAMATION WORKS IN GERMANY.

A ten year plan for land reclamation on 150 miles of coast is now in course of execution in Germany. A total area of 1,250,000 acres representing a strip 13 miles wide on the 150 miles of coast lies within the scope of the work. A chain of islands representing the mediæval province of Freisland lies a short distance off the coast and the object of the reclamation work is to recover all the land between the islands and the mainland. The method of reclamation being followed is to form large sheltered areas by the construction of stone pitched dams which frequently serve to connect the mainland with the islands. Within the sheltered areas smaller enclosures 400 yds. wide are formed by means of double rows of piles with mats anchored with stones in between. These areas are allowed to silt up. A drainage system is provided to take away the water rapidly so that the newly deposited silt may get consolidated before the next tide.

THE VIBRATION OF CONCRETE. Walsh.

Vibration as a means of consolidating concrete is rapidly becoming more commonly used. There are two main reasons for this :

1. The reduction of labour in placing and compacting concrete.
2. The satisfactory placing and compaction of concretes that are too stiff for consolidation by tamping. A stiff mix with low water cement ratio results in high strengths and densities.

This article describes five different methods of applying vibration to concrete, namely the vibrating table, external vibration, surface vibration, internal vibration, and combined surface and internal vibration. A few types of vibrators are described, and the advantages of various methods of vibration are discussed. Frequencies suitable for different methods of vibration are mentioned. In a U. S. Government work at Davenport comparison was made between hand placed concrete and concrete placed by internal vibrator, and it was found that with the same water cement ratio both the cement and the sand in the mix could be reduced without detriment to the quality.

A special form of surface vibrator has recently been developed in France for compacting and finishing concrete protection on the side slopes of canals and reservoirs. Working on a side slope of 2 :1, one of these machines placed 290 sq. yds. of cement 6 inches thick per day of 8 hours. The surface finish was good and required no trowelling. Outputs of vibrators as obtained in the London area are given. In conclusion the author gives a summary of recommendations for the use of external, internal, and surface vibrators which will be very useful in practice.

THE FACTOR OF SAFETY IN PILE DRIVING. **Allin.**

The pile driving formulæ which have been in general use up to recent years usually contain constants varying between 6 and 12 selected by their authors as factors of safety. This procedure was justified in view of the empirical character of the formulæ. But in modern rational formulæ there is no reason why a more discriminating choice of a factor should not be made so as to suit individual conditions. The rational impact formula for piles is based on certain assumptions which are not fully justified. There is thus a gap between theory and practice and this article discusses some aspects of this gap with a view to discover means of bridging this gap by practical measures and suitable adjustment of the factor of safety. The main discrepancies between theoretical and actual values of resistance to penetration for cohesive and non-cohesive strata are explained and allowances to be made for factor of safety are given.

BELLMOUTHED WEIRS AND TUNNEL OUTLETS FOR DISPOSAL OF FLOOD WATER. **Binnie.**

Extracted from a paper read before the Institution of Water Engineers. Early applications of this type of overflow date back to 1896 and in many cases the use of this type has resulted in considerable reduction of costs. A table giving particulars of various designs of bellmouth overflows used in a number of actual works is included.

In designing several of these, model experiments were undertaken to determine the best shape of the bellmouth and also to determine their behaviour under operating conditions. The experiments carried out for the Jubilee reservoir in Hong Kong are described in some detail and the conclusions arrived at given. Other experiments and improvements carried out as a result are also mentioned.

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NOTES OF THE MONTH.

ROAD RESEARCH.

The second annual report of the Road Research Board for the year ended March 31, 1936 has been published. Many road failures have been shown to be due to the foundations giving way. The report describes tests which have been devised to investigate the characteristic properties of soils. Flaky and elongated material is unsatisfactory for road construction. Practical methods for studying and measurement of the shape of road aggregates have been devised.

In concrete roadwork, it is extremely difficult to secure a rigid control of mixtures, especially with reference to the water content. Three road testing machines are being used to find the relative strength of different bituminous constructions. A standard machine consisting of a motor cycle with sidecar has also been developed for the study of skidding.

AIR CONDITIONING IN THE TROPICS.

A new and economical method of insulation against radiant heat by means of reinforced aluminium foil has recently been demonstrated. As a result of experiments carried out it has been possible to produce a portable cubicle, coupled with a small air conditioning unit which can be plugged into an ordinary electric supply, and so enable the conditions inside the cubicle to be kept at an even temperature and humidity, irrespective of the surrounding conditions.

STRUCTURAL WELDING: A STUDY OF GERMAN PRACTICE: SIGNIFICANT CONTRASTS.

Bondy.

Describes three types of welded building structures now being erected in Germany and deals with the principal features of the three types. Formulæ required for the design of a few types of two pin structures which are the most common and favoured types of welded construction in Germany are given.

THE BEHAVIOUR OF PILES IN COHESIVE SOILS.

Allin.

When re-driving piles after a period of rest into water bearing cohesive soils of low permeability such as soft clay, loams, and fine grained silts, the resistance to penetration of the piles shows an increase of value. Such is not the case in highly permeable and non-cohesive strata. The period necessary for the full resistance to develop after driving is estimated between one and two days and varies with the moisture in the soil and its degree of permeability. The author discusses the causes of this phenomenon in the case of clay and considers whether this improved resistance of the pile after a period of rest should be taken advantage of in design. This improved resistance is to be ignored in the design of piles subjected to shock or vibration but may be taken advantage of where piles are not likely to be subjected to any disturbance.

SINKING MONOLITHS AND CAISSONS IN COMPRESSED AIR.

Cogdon.

For building concrete quay walls in deep water, sinking of monoliths or caissons in compressed air is the most adaptable to any circumstances but the cost of this method is very high. The principal advantage of the method is that the foundations of the proposed structure can be inspected in their natural state. The essential features of a caisson are described and the steps in the sinking of a caisson from the pegging out on the site to the completion of sinking operations and filling with concrete are described, and the precautions necessary in sinking the caissons are mentioned. Principal features of the compressed air plant are briefly described. Special reference is made to two types of monoliths and caissons used recently in the construction of a deep water quay. The design of these monoliths and caissons is described and an account of their sinking is given. They were sunk through magnesium limestone with a mean rate of sinking of 1 to 2·75 ft. per 24 hours.

THE EXAMINATION OF WELDS BY X-RAYS. Schons.

Describes a recent development of testing welded joints by X-Ray apparatus.

THE LATERAL FORCES ON STANCHIONS IN SINGLE STORY BUILDINGS. Voce.

This is the concluding article of a series which appeared in previous issues. Certain diagrams are given from which deflection factors can be calculated to obtain deflections in different types of stanchions. The use of the diagram is illustrated by several examples.

TESTS ON SHRINKAGE OF CONCRETE. Shank.

Results of certain experiments with plain concrete and reinforced concrete specimens for the determination of shrinkage and shrinkage stresses are given in this article. The specimens were made of concrete having five different cement water ratios and measurements were taken over a period of 500 days. The results are shown graphically and are analysed and discussed. Some of the conclusions arrived at are :

1. Richness and strength have no apparent effect on the shrinkage.
2. There is a sudden change in the rate of shrinkage at some time after exposure to dry air, about two months in the case of the specimens concerned.

NEW DIAGRAM FOR THE DESIGN OF CHANNELS.

A diagram is given from which dimensions of channels of capacities from 0 to 3000 cusecs having 1 to 1 side slopes and a value of Kutter's N = ·030 could be quickly and accurately determined. Corrections are given at the top of the diagram which enables channels with other side slopes and values of N to be worked out. Several examples illustrating the use of the diagrams are worked out.

No. 374—August 1937.

NOTES OF THE MONTH.

NEW WATERLOO BRIDGE.

The new Waterloo bridge, the construction of which will shortly commence consists of 5 spans of 238 ft. Each span will consist of twin arches side by side with a flat soffit 33 ft. wide between them. The arches and flat soffit will be of reinforced concrete. Much of the concrete in the bridge will be vibrated.

THE GABEL AULIA DAM.

This dam which is the longest in the Egyptian system is situated in the Sudan some 25 miles south of Khartoum on the White Nile, and has recently been completed. The Blue Nile and the White Nile join at Khartoum. The Blue Nile carries a very large volume of water during the flood period July to September, as compared to the White Nile. The heavy flow of the Blue Nile tends to pond back the White Nile to a distance of 200 miles above their junction. Towards the end of the rainy season the diminution of flow of the Blue Nile releases this ponded up water, causing a surge late in the year. The Gebel Aulia Dam has been constructed with a view to holding back the White Nile, and releasing its waters gradually thus preventing the surge.

The total length of the structure is 4998 metres. It consists of two sections, a masonry dam 1693 metres long, and an embankment with an impervious concrete core wall 3305 metres long. The masonry dam consists of two lengths of solid section, and a length containing 60 sluices and lock in between. The masonry section of the dam is of granite throughout while that of the embankment section is of compacted filling faced with mosaic sandstone pitching. The dam has a continuous roadway on top 4·5 metres wide.

The underlying formation at the site consists of friable sandstone into which a continuous cut-off wall has been tied. The cut-off trench is 1·5 metres wide, and 2 metres deep in the solid rock. Granite rubble masonry set in 2 to 1 cement mortar was used in the trench to form a cut-off wall. The main body of the dam was built of granite rubble masonry set in 3 to 1 cement mortar. The upstream and downstream slopes are faced with semi-dressed hexagonal mosaic granite blocks. The upstream slope has a batter of 1 in 40 while the downstream slope has a batter of 1 in 1¾.

The sluice section consists of 60 sluices 4·5 metres high by 3 metres wide, fitted with rolled steel gates.

The embankment dam consists of a core wall of 6 to 1 mass concrete 3 metres wide carried down to the rock and keyed therein. The upstream slope is 2 to 1 and the downstream slope 3 to 1. The slopes are faced with heavy sandstone mosaic pitching. On the upstream side, large blocks of sandstone are placed, extending from the toe of the embankment up to high water level, to serve as wave breakers.

The length of the reservoir created by the dam will be 300 kilometres with a maximum width of 7 Km. The usable capacity is estimated to be 3,500,000,000 cubic metres.

THE ALLINGTON SLUICES.

These sluices are situated at the junction of the tidal and non-tidal reaches of the river Medway and were constructed as part of a comprehensive scheme for flood alleviation in the Medway Valley. The new gates consist of 3 vertically rising roller gates electrically operated. The structure consists of a reinforced concrete floor slab, massive concrete piers and abutments, and a reinforced concrete foot-bridge and superstructure. The floor slab is designed as continuous beam so that the weight is spread uniformly over the whole breadth of the foundations. Other features of the structure are described.

FLOOD CONTROL FOR LONDON RESERVOIR.

The Brent Reservoir is situated in the Urban Districts of Hendon, Willesden and Kingsbury and is being utilized for the supply of water to the Grand Union Canal. Escape for flood water was provided by means of an arched masonry weir and two culverts. Under the Reservoirs Safety Provisions Act of 1930, the existing means of disposal of flood water were considered inadequate and additional means of disposal of flood water in the shape of 5 siphons were constructed in the body of the old weir in such a manner as not to interfere with the culverts which would normally discharge the water, the siphons coming into operation in an emergency. The siphons are briefly described, with illustrations.

CONCRETE AND CONSTRUCTIONAL ENGINEERING.

VOL. XXXII.

No. 6—June 1937.

DESIGN OF ARCH ROOFS. Terrington.

This is the first of two articles on the method of calculating the bending moments, thrusts and shears at any point in reinforced concrete roof arches. Roof arch problems are essentially different from bridge arch problems because roof arch profiles are not generally smooth and regular curves. A method of direct calculation in the case of some types of roof arches with freely supported and fixed ends is outlined in this article. The method is based on the elastic theory which gives the only satisfactory solution of all arch problems. A number of equations giving bending moments and thrusts, etc., for points on the arch profile for vertical loads, and horizontal or wind loads are derived from first principles. An actual example is worked out illustrating the use of the equations.

THE BOULDER DAM.

Extracted from a lecture on the Builder Dam delivered to the Institution of Civil Engineers by Mr. J. L. Savage, Chief Designing Engineer, Bureau of Reclamation, U. S. A. It deals mainly with interesting points in connection with the preparation and placing of concrete in the dam and diversion tunnels. (See page 60 of Bulletin No. 6).

THE IMPACT TEST FOR PILES.

Comments on an article published in the March issue of the journal. (See page 27 of Bulletin No. 6). The writer considers that the author of the original article hardly does justice to the advantages of the present method of impact test and discusses these advantages. He questions the value of driving test piles in determining the bearing capacity of pile groups which varies greatly in different kinds of ground, and considers the procedure to be expensive.

Mr. Pimm, the author of the original article in replying to the above comment says that the method of driving test piles is not expensive because the tests are made by means of a special test pile which is recovered, the same pile being used throughout the job. A site can be completely covered with the special test pile and there can be no difficulty in determining the bearing capacity of pile groups.

THE MODULAR RATIO : A NEW METHOD OF DESIGN OMITTING m.

Comments on the above paper published in previous issues of the journal by a number of correspondents.

VIBRATING CONCRETE ON SLOPES.

Describes a novel method of vibrating concrete placed in the sloping sides of an aqueduct 5576 yds. long on the channel leading to the Champanbest-aux-Bois Reservoir. The vibrating apparatus consists of a travelling platform fitted with a vibrator composed of a steel plate 6 ft. 6 in. long having a useful width of 18 inches and rounded at the edges and stiffened by angle irons. Welded lugs on this plate receive the blows of the pneumatic vibrators.

This plate is moved up and down the slope by hand winches connected to an axle mounted on rollers travelling along the channel sections which form the inner sides of two ladders on either side of the plate. The ladders form a working platform whose plane is parrallel to the slope of the channel side. The ladders are connected at the top and bottom by cross girders which move horizontally on channel rails in the direction of the channel. After vibration is competed on a certain width of the slope the platform moves forward. complete with vibrators, to the next adjacent strip.

SOIL LINE METHOD OF RAFT DESIGN. Baker.

The concluding article of a series on the design of beams and rafts for foundations and basement floors. In this article a comparison is made of results of soil line method with exact elastic support method and it is shown that results from the former are as reliable for all practical purposes as those from the latter. The method is rational and effects large economies which more than justify a little expenditure on experimental work to find safe values of the basic soil constants which are required for this method.

A NEW TAMPING MACHINE.

On the construction of the San Gabriel Dam in U. S. A. a power driven tamper weighing about half a ton is being used. The machine consists of a four cycle single cylinder internal combustion engine designed to lift the device bodily by using the energy generated in the explosions. The device is in the shape of a heavily truncated cone to the top of which handlebars and a petrol tank are attached. Dry cell batteries and an ignition coil are carried on the operator's back. Explosions are produced by a push-button contact operated from the right handle bar. The machine leaps upward by 9 inches and moves forward at the same time by the same distance, guided by the operator who manipulates the handlebars. Fifty blows a minute can be delivered to the surface to be compacted. The average performance is about 3000 sq. ft. per hour of operation.

No. 7—July 1937.

DESIGN OF ARCH ROOFS. Terrington.

Continued from previous issue. The method of calculating horizontal thrust and tangential shear at any point of an arch section is explained and examples are worked out to illustrate the procedure for various types of support and conditions of loading.

THE MODULAR RATIO: A NEW METHOD OF DESIGN OMITTING m.

Further comments from a number of correspondence on the series of articles on Prof. Saliger's method of calculating reinforced concrete without the use of a modular ratio.

CEMENT PAINT.

A cement paint is being manufactured in England under the trade name of "Ellicem". It is supplied as a powder which when mixed with water is claimed to adhere firmly to brick, plaster, metal, glass, concrete, etc., without the necessity of roughening the surface. The paint is quick setting and is stated to give a hard weatherproof stone-like finish which continues to harden over a period of months and will not crack due to expansion or contraction.

No. 8—August 1937.

ALVELEY BRIDGE. Mason.

The fundamental problem in the construction of the bridge described in this article was to overcome the difficulty in bridging a river liable to sudden floods bringing down heavy debris which would make the use of falsework supported in the river bed hazardous. The bridge was erected by cantilevering out consecutive sections from each bank until the gap became small enough to close in one operation. The bridge is on the river Severn and consists of a river span of 150 ft. and two shore spans of 60 ft. There are two parallel girders continuous over three spans and monolithic with the river piers which sustain the greater part of the weight of the bridge. Details of construction operations are described.

DESIGN OF DOMES. Terrington.

An article describing in full detail the method of design of a reinforced concrete dome. An example is worked out to illustrate the method.

STRESSES IN ARCH SECTIONS. Saunders.

After obtaining the value of moment and normal thrust, the accuracy of calculated stresses in an arch rib depends upon the accuracy with which the proportionate depth to the neutral axis is obtained. Several methods are used including trial and error. A direct graphical method is indicated in this article and an example of its use is given.

THE MODULAR RATIO—A NEW METHOD OF DESIGN OMITTING m. Kazinczy.
Guldan.
Pogany.

Further comments on this paper published in January, February and March 1937 issues of this Journal are given.

THE ENGINEER.

VOL. CLXIII.

No. 4245—May 21, 1937.

THE GEBEL AULIA DAM.

The Gebel Aulia Dam on the White Nile near Khartoum has recently been completed four months in advance of the scheduled time. It has a total length of 3 miles and a height of 60 ft. and is the longest in the Egyptian Irrigation System. (See also under "Civil Engineering & Public Works Review", August 1937 in this Bulletin).

MODERN HYDRAULIC TURBINES. Watson.

Continued from previous issue. Describes some types of control mechanism of modern turbines including governors and relief valves.

No. 4249—June 18, 1937.

CHESTER WATERWORKS IMPROVEMENTS.

Describes a reinforced concrete service reservoir recently built with a capacity of 10 million gallons, and a reinforced concrete water tower with a capacity of 200,000 gallons and having a total height of 102 ft. from ground level.

AMERICAN ENGINEERING NEWS.

VIBRATING CONCRETE PAVEMENT.

In road building work, the State Highway Department of Illinois has experimented with the vibratory treatment of concrete, with satisfactory results. On recent work half was done with stone concrete and half with gravel concrete, divided into two classes, one ranging from 2 inches to 1 inch in size and the other from 1 inch down to ¼ inch in size. In gravel concrete, the most workable mixture had 40 per cent. of the coarser and 60 per cent. of the finer aggregate while in stone concrete the proportions were 35 and 65 per cent. High frequency electric vibrators were fitted to the finishing machines and the vibration frequency ranged from 3950 to 4075 impulses per minute. The finished work met all expectations and had greater strength at normal cost.

No. 4250—June 25, 1937.

A NEW ZAMBESI BRIDGE.

This is a suspension bridge to be constructed on the Zambesi at the Chirundu Gorge and will form an important link between Northern and Southern Rhodesia.

BEACH EROSION.

The Chief of Engineers, U. S. Army, appointed a board known as "The Board on Sand Movement and Beach Erosion" for the purpose of conducting investigations on the erosion of breaches which has assumed serious proportions of late. The Board has published an interim report which places the information obtained up to the present in a form which can conveniently be referred to by persons interested. The main line of investigations included a study of the sand movement, relation of sand size to shape of foreshore, littoral drift and breach improvement by groynes. The findings and conclusions of the Board with regard to the various investigations conducted are discussed.

VOL. CLXIV.

No. 4251—July 2, 1937.

MOSQUITO CONTROL ENGINEERING.

Abstracted from a series of articles published in the Engineering News-Record in July 1936. (See pages 52—54 of Bulletin No. 3).

MISCELLANEA.

A new rustproof paint has recently been put on the market. It is formulated on a chlorinated rubber base and is known as "rust-eeter". When applying the paint it is not necessary to clean off all the rust on a metal but merely to clean off loose scale and grease, and when the paint is applied it reacts on the rust and transforms it into an essential part of the protective coating. It is applied either by brush or spraying and sets in twenty minutes.

No. 4252—July 9, 1937.

THE ROYAL SHOW AT WOLVERHAMPTON.

A motor garden cultivator, a motor plough, and a grass drying plant are described. These were exhibited at the Royal Show at Wolverhampton held from 6th to 10th July 1937.

THE INLAND WATER SURVEY OF GREAT BRITAIN. Hetherington.

(See also under "Water & Water Engineering", July 1937 in this Bulletin).

No. 4253—July 16, 1937.

THE ROYAL SHOW AT WOLVERHAMPTON.

Describes a mobile grass drying plant and a number of other grass drying plants, a grass cutting and loading machine, a weed cutter and a rapid trench digger exhibited at the show.

ENGINEERING NOTES FROM CHINA.

NEW IRRIGATION METHODS IN CHINA.

An enormous area in China is devoted to the cultivation of rice. For thousands of years the rice fields were irrigated by lifting water by man power from rivers and canals on to the fields. In recent years a large number of small boats have been equipped with portable oil engine pumps in Central China. Owing to poverty of the rice farmers, the Chinese agents of the Oil Companies purchase the machinery and guarantee to the farmers satisfactory irrigation at an agreed annual rate per acre irrigated.

THE REINFORCED CONCRETE ASSOCIATION.

The Chairman of the Association reviewed the work of the Association in 1936 at its recent annual general meeting. The Chairman's address is briefly outlined in this article. In describing the Association's research work it is stated that work on redistribution of moments in reinforced concrete beams and frames was completed. An investigation into the cause and prevention of cracking is in progress and the results obtained so far have been published. The effect of the grading of aggregate on the strength and workability of concrete has been studied.

No. 4254—July 23, 1937.

MISCELLANEA.

A NEW BUILDING MATERIAL.

A new building material which is said to have high insulating and acoustical values and at the same time to be fireproof, moistureproof, verminproof and impervious to decay has recently been put on the market in the U. S. A. The name of the material is 'mikolite' and it is produced by heating a micacious mineral ore at 2000°F for 15 seconds. It is claimed that it is the only known micacious material capable of withstanding mixing action without breaking down, and having an affinity for binders such as cement gypsum, etc.

THE DEVELOPMENT OF IRRIGATION IN INDIA.

A review of the statistical report on Irrigation in India for the year 1934-35 published by the Department of Industries and Labour of the Government of India. The area irrigated from Government works amounted to 29,880,000 acres which is nearly one-seventh of the whole area under crops in British India. The gross revenue from water rates was Rs. 1,234 lakhs and the working expenses Rs. 492 lakhs showing a net return of 4·9 per cent. on the Capital Expenditure. The estimated value of the irrigated crops is

Rs. 9,111 lakhs. The two largest projects recently completed but not yet fully developed are the Lloyd Barrage Project and the Mettur Dam. Other major schemes which are under consideration are the Tungabhadra Project in the Madras Presidency, The Haveli Project in the Punjab, the Grand Trunk Canal in Bengal, and the Gumal River Scheme in the North West Frontier Province.

The formation of the Central Board of Irrigation and the Research Committee of the Board is described and some of the problems before the Research Committee are mentioned. These include waterlogging, canal lining, and use of models in connection with investigations of the meandering of rivers.

No. 4255—July 30, 1937.

RIVER NENE IMPROVEMENT WORKS.

Works are now being carried out to improve the river Nene which flows into the Wash. Much of the projected work consists of dredging, bank protection by piling, and construction of a number of locks and sluices. These works are briefly described. A portion of the river is being canalised and forty-four locks are being constructed in this reach.

A NEW DEEP WATER SUPPLY FOR CROYDON.

A deep well is being constructed for the water supply of the Borough of Croydon. A special method of well boring is being used, and a 17 inch test hole has been drilled to a depth of over 1,100 ft. in less than 300 working hours. A feature of the system is the use of a continuous stream of liquid clay which is pumped down through the hollow rods of the rotating drill. It emerges through orifices in the bit and then rises up the borehole, overflowing into a settling tank at the top whence it is drawn into the pump again. This circulation of liquid clay provides a means of washing out the debris from the drill and carrying it in suspension into the settling Tank.

If the stratum is porous, some of the clay is absorbed and this fact is indicated by a drop in the level of the clay which returns in the settling tank. When the test boring has been completed to a depth exceeding that to which it is intended to drive the well, work is suspended, leaving the clay to settle in the hole. As it settles, it dries and provides an impermeable coating right down the tube. The well is mechanically reinforced against caving in and all natural water flow from permeable strata is sealed off.

The various stages of the well sinking operation are described and explained with the help of sectional diagrams. A high pressure pump is used for the circulation of the liquid clay. After placing the steel casing tube in position, a liquid mixture of pure cement and water is circulated by the same high pressure pump and a permanent cement seal about an inch thick is formed round the casing.

No. 4256—August 6, 1937.

STANDING WAVE PROBLEMS, NO. I. Blench.

This series of articles refer to the two problems (*a*) determination of the position of the standing wave on a gently sloping weir glacis and (*b*) design of a fall so that the standing wave shall not move off the glacis on to the channel bed. In this article, which is the first of a series of three, the graphical representation of Bernouilli's equation and the hydraulic jump equation, are discussed. The energy of flow at a section is defined, and the procedure of obtaining energy of flow diagrams is described. The method of drawing the water profile for a flume which both contracts and depresses, in a channel with given conditions of flow is explained. The flow through such a flume is analyzed and a number of energy relations are developed, and their practical significance is interpreted. In commenting on the practical aspects of the flume problem the author considers that the depressed bed flume should have a future. Constricting channels in bridges is generally avoided on the grounds of afflux and jetting but the author's analysis of flume flow makes it clear that greater constriction is possible without fear of afflux if the cross section is made up by depressing the floor. The presence of a rising floor helps to spread the jet. As a satisfactory example of a flume the author mentions a flume for 250 cusecs, with normal width of 25 ft. flumed to 5 ft., a throat length of 10 ft., and a depression of floor of 3·6 ft. The design of long crested weirs is briefly discussed.

The author then explains the graphical representation of the hydrualic jump equation. The energy of flow diagrams and impulse plus momentum diagrams for a hydraulic jump are depicted, and the principle underlying the finding of the position of the standing wave is explained.

ALLINGTON TIDAL SLUICES.

These sluices were constructed as part of a scheme for flood alleviation in the Medway Valley. These are described in this article. (See also under "Civil Engineering and Public Works Review", August 1937 in this Bulletin).

No. 4257—August 13, 1937.

STANDING WAVE PROBLEMS NO. II. Blench.

This is the second article of the series and discusses some standing wave problems and their solutions. Some of the problems treated are : wave on the downstream floor with clear trough and trough full of water; and wave on gently sloping gracis with trough empty and full. In the course of the theoretical discussion of the problems a number of mathematical relations are developed and practical comments are offered for each problem in which the practical significance of the relations derived as affecting design of actual works is explained.

DRUM WEIR WITH SEPARATELY DRIVEN WING.

Describes a weir erected at Guttenbach, Germany, which consists of 3 bays of 30 metres each, in each of which there is a steel drum. At each end, the drum carries a pinion engaging with a rack fixed in the pier, and at one end a chain is wound round the drum and attached to it, whilst its other end is wound on to a winch. The arrangement is such that by the operation of the winch the drum is caused to rotate and so under the action of the pinions, climbs up the racks, freeing the opening for the discharge of flood waters. The drum weir is particularly suitable for use in rivers which carry a considerable amount of drifting matter or where winter conditions are so severe that ice is likely to be formed.

No. 4258—August 20, 1937.

STANDING WAVE PROBLEMS. NO. III.

Blench.

This is the final article of the series and in the words of the author "the object of this section is to derive rigidly the equations of motion of jump with empty and full troughs on a flat floor; estimate the error likely to occur through neglecting vertical acceleration; suggest a theory of curvatures for jump from the bottom of a steep glacis and indicate the problem which requires to be solved for the jump on a glacis".

THE GERMAN MOTOR ROADS.

A network of arterial roads for exclusive motor traffic is being constructed in Germany and is called the "Autobahn" network. The roads are being built to three standards depending on the country through which the road passes. The three standards are suitable for speeds up to 110 miles an hour. The standards are based on theoretical considerations of the requirements of a vehicle moving at high speed, modified to some extent by practical knowledge. As a result of theoretical investigations curves have been prepared showing the sighting distance, speed and vertical curvature relationships, and the speed radius of curvature and superelevation relationships. These curves have been reproduced. The maximum gradient, radius of horizontal curves, and minimum radius of vertical curves for the three types of road are given in a table. The roads are being constructed of concrete. Joints of various kinds have been used and research work is in progress to determine the most satisfactory type of joint. The road consists of two one-way carriage ways 7·5 metres wide, separated by a green strip 3·5 to 5 metres wide.

No. 4259—August 27, 1937.

THE GERMAN MOTOR ROADS.

Continued from previous issue. Contains a general description of types of road junctions, road bridges and other adjuhcts being used in the construction of the "Autobahn" system in Germany. The article concludes with a plea for the launching of a similar roadbuilding scheme in England.

No. 4260—September 3, 1937.

MISCELLANEA.

CEYLON HYDRO-ELECTRIC SCHEME.

A new hydro-electric scheme will soon be commenced in Ceylon. It will supplement the existing supply system of Colombo. It entails the construction of a dam 345 ft. long and 94 ft. high. The water impounded will be conveyed through a tunnel 7863 ft. long to a surge chamber whence it will be conducted through pipe lines to the power station 1,500 ft. below. The power station will house three pelton wheel type water turbines coupled to alternators, the total capacity of the plant being 25,000 k. w.

AIR CONDITIONING IN A HONG KONG BANK.

Smith.

This article gives details of their conditioning plant installed at the Hong Kong and Shanghai Bank Building in Hong Kong about a year ago. The plant has to deal with 2,300,000 cu. ft. of enclosed air, and is the largest in the tropics. The building covers a floor space of 56,000 sq. ft. and is 247 ft. high with thirteen floors above ground level, and a basement. The whole of the air in this huge building is conditioned and there is constant but unobtrusive ventilation. In the nine summer months from April to December the air is cooled; in winter, the conditioned air is heated before it is introduced into the rooms and the temperature is maintained by hot water heating panels hidden in the ceilings of the rooms. The plant consists essentially of an air washer to cool and purify the air, a circulating fan to distribute the air to the various inlets to rooms, air ducts for supply and exhaust air, and refrigerating plant for the air washer. Detailed description of the installation is given and the local working conditions are discussed. The cost of the installation was £100,000.

No. 4261—September 10, 1937.

AIR CONDITIONING IN A HONG KONG BANK.

Middleton Smith.

Continued from previous issue. The working of the air conditioning plant at the bank is described and its effects in general is discussed. The principal advantages mentioned are the saving of fans, cleaning, absence of dust, less depreciation of furniture and increase in human efficiency.

THE BRITISH ASSOCIATION No. I.

The British Association for the Advancement of Science met at Nottingham in September 1937. Section G concerns engineering and the proceedings of this section include a lecture on the Trent Catchment Board in which the prógramme of improvement of the catchment area of the river Trent is briefly outlined. The scheme comprises tidal bank works, regrading and resectioning of the river in several reaches, construction of flood relief channels and sluicing of solid weirs.

THE GEOGRAPHICAL JOURNAL.

VOL. LXXXIX.

No. 5—May 1937.

THE TENNESSEE VALLEY PROJECT.

Barbour.

The main features of the Tennessee Valley Project now under construction in the U. S. A. are described in this article. The project plans to utilize and regulate the water resources for navigation and power, to introduce cheap electricity for use in homes and farms, to develop the mineral resources of the area, to check erosion by soil conservation measures and to provide flood control. Some of the more important objectives of the scheme and the means of attaining them are discussed. The scheme involves the construction of a number of dams along the river to provide storage and improve navigation. The dams are being constructed serially. Steps taken to combat erosion are described. An abandoned nitrate factory is being utilized to manufacture artificial fertilizers for the improvement of land. (See also pages 79 to 85 of Bulletin No. 5).

THE TRANSPORT OF SAND BY WIND.

Bagnold.

In this article the author gives an account of recent experimental work carried out by him on the process by which sand is moved by a wind over surfaces of sand and pebbles. According to the author the subject is a special case of the general problem of the transport of solid particles by fluids. He describes in general the behaviour of sand grains under the action of wind and compares an actual photograph of the motion of sand particles with some calculated theoretical paths. He then goes on to describe his experiments which were carried out in a specially constructed wind tunnel and gives a detailed treatment of the problems investigated and results obtained. An explanation for the phenomenon of dune growth is offered, and a formula giving the mass displacement of sand in terms of the wind gradient has been arrived at. A method is given whereby the annual sand movement over a large tract of country may be computed from existing meteorological records.

HEATING & VENTILATING ENGINEER.

VOL. IX.

No. 108—June 1936.

AIR CONDITIONING BY REFRIGERATION AND OTHER METHODS.

Henly.

Continuation of an article from a previous issue on the use of refrigeration and other methods of air conditioning.

PIPE SIZING FORMULÆ—ALLOWANCE FOR VISCOSITY AND VELOCITY FACTORS.

Clementson.

In the May issue of this journal there appeared an article entitled "Temperature, Viscosity and their influence upon the flow of water in pipes". The present article is based on the conclusions drawn therein; the writer shows that the values arrived at can be reconciled to well-known pipe friction formulæ.

JOURNAL OF THE INSTITUTION OF CIVIL ENGINEERS.

No. 7—June 1937.

THE RECONSTRUCTION OF THE CHESTER—HOLYHEAD ROAD NEAR PENMAENMAWR, NORTH WALES.

Humphreys.

The old road proved unsuitable for modern traffic and a new alignment was decided upon. The features of this new road are described in this article. The road runs along a mountain side in part of its length and passes through a tunnel in the rock 565 ft. long. Other works of importance are a reinforced concrete slab viaduct and a bridge of reinforced concrete consisting of seven fixed arch spans of 80 ft. The arches are five centred. Details are given of side hill cuttings, retaining walls, the tunnel, the viaduct and the bridge; foundation conditions and operations are described.

THE FLOW OF THE RIVER SEVERN, 1921-36.

Dixon.
Fitzgibbon.
Hogan.

This paper gives data of river-flow investigations of the river Severn. It deals with methods of discharge measurements, selection of gauge sites, relationship between gauges and discharges, calculation of daily discharges, hydrographs of river-flow, rainfall, and run-off. In an appendix results are discussed of the surface float method of measuring discharges for which observations were carried out simultaneously with current meter discharge observations. Current metres were however generally used.

THE BOULDER DAM.

Savage.

A lecture on the Boulder Dam delivered before the Institution of Civil Engineers by the Chief Engineering Designer, Bureau of Reclamation. (See page 60 of Bulletin No. 6).

THE ESTIMATION OF RUN-OFF AREAS SUBJECTED TO RAINSTORMS.

Daymond.

An abstract of the original paper is given herein. The paper contains a brief general discussion on existing theory of the relationship between rainfall and run-off which is based on Kuichling's law first enunciated in a paper published in the Transactions of the American Society of Civil Engineers, 1889. Subsequently, a rational formula for run-off was evolved by another author based on Kuichling's law. The present author discusses the justification for and the limitations of this formula which does not account for certain factors such as the shape of the area, slope of ground, etc. He then proposes a new general theory which does not suffer from the limitations of the old one and leads to greater exactitude in the estimation of flow. The general type of equation derived by the author is discussed and the methods of solution are indicated. Examples are given to show the effect of the shape of area and of intensity of rainfall curve upon the run-off, and the assumptions made in the development of the general theory are considered together with the values of run-off resulting from such assumptions.

THE ROYAL ENGINEERS JOURNAL.

Vol. LI.

September 1937.

Quetta Reconstruction.

King.

This article gives a general outline of the progress of the work of permanent reconstruction at Quetta.

Forestry.

Molesworth.

A general article on the theory and practice of forestry dealing with the processes at work in a mature tree, the various phases in the growth of a tree and the planting and care of trees.

WATER AND WATER ENGINEERING.

Vol. XXXIX.

No. 476—March 10, 1937.

(Manufacturers' Annual Review Number).

There is nothing of interest in this to irrigation engineers.

No. 480.

Not yet received.

No. 481—July 1937.

The Inland Water Survey of Great Britain.

Hetherington.

A paper presented before the British Waterworks Association.

Great Britain has recently awakened to the need of a comprehensive survey of its water resources as is evidenced by the appointment of the Inland Water Survey Committee, the object of which is to advise on the Inland Water Survey for Great Britain, on the progress of the measures undertaken, and on further measures required. In previous years any water survey work undertaken has been limited to the needs of the agency conducting such survey. The enormous growth in population and industrial activity has made it imperative to initiate a water survey in order to prepare a reliable inventory of the water resources of the country which will serve as a guide in future water undertakings. The information needed relates to rainfall, surface water, and ground water. The procedure of survey as recommended by the Committee is discussed. Other features of the survey such as direction and control, interpretation of results, inspectional arrangements, financial considerations, and character of the results of the survey are briefly reviewed.

BELLMOUTHED WEIRS AND TUNNEL OUTLETS FOR THE DISPOSAL OF FLOOD WATER.

Discussion by several members on the above paper by Mr. W. J. E. Binnie presented to the summer meeting of the Institution of Water Engineers, and Mr. Binnie's reply to the discussion.

No. 482—August 1937.

EDITORIAL NOTES.

BENTONITE AS A COAGULANT.

The coagulating value of bentonite has been investigated by two American University Professors of Chemistry. Dispersed in turbid waters containing mineral matter, the sodium bentonites can be used effectively for coagulation in treatment of waters having a definite minimum concentration of dissolved electrolytes. In the case of waters carrying calcium salts they have a softening effect also.

No. 483—September 1937.

STOCKPORT WATER SUPPLY.

A new scheme for the supply of water to the town of Stockport is under construction. The complete scheme comprises two impounding reservoirs, catchwaters, filtration plants, two service reservoirs, aqueducts, trunk mains, etc. One of the reservoirs, the Fernilee reservoir, has recently been completed. It covers an area of 86 acres and is formed by an earthen dam with a puddle core, 650 ft. long, and 132 ft. high. The puddle core section is founded on the concrete which lies in the central cut-off trench and which goes to a depth of 232 ft. below ground level. Details of all the works comprising the first instalment of the scheme which has been completed are given.

WATER LEVEL, FLOW GAUGING AND METEOROLOGICAL STATIONS. PART II.

McClean.

The first part of this paper was published in June 1937. This article deals with flow and storage measurements and their scope and application, and the graphical representation of the records of water level flow and storage. Application of the records to the solution of various problems are explained.

The procedure of flow gauging and the preparation of tabular and diagrammatic records from the observed data are explained in detail. Some of the problems for the solution of which the records can be applied are : the assessment of water resources, the preparation of hydrographs of river flow, water power problems, water supply problems and storage problems.

THE DAYMOND THEORY OF STORMWATER RUN-OFF APPLIED TO RESERVOIRED CATCHMENT AREAS.

Lloyd.

Until recently the theory of relationship between intensive rainfall and stormwater run-off has been based on Kuichling's law. Recently the scope of Kuichling's rational formulæ has been enlarged and a general theory has been proposed by Daymond. The object of this article is to indicate how the Daymond theory may be extended to include a condition occurring on a catchment of moderate area which may be capable of being reservoired.

FOREIGN AND COLONIAL.

THE WATER SUPPLY OF QUETTA.

Describes briefly the Spin Karez project for the water supply of Quetta (See page 13 of Bulletin No. 3).

Special Supplement to September 1937 issue.

This supplement is entitled "Large Dams" and contains a few papers and summaries of others presented at the Second Congress on Large Dams held in U. S. A. in September 1936. The papers are as below.

DAMS BUILT OF PRECAST CONCRETE BLOCKS

Halcrow.

This article suggests the use of precast concrete blocks instead of mass concrete in the construction of large dams. The chief advantage claimed is that all shrinkage due to cooling of the concrete while setting takes place before the concrete blocks are placed in the dam. Cracks which are common in mass concrete dams will thereby be eliminated, and the prevention of vertical shrinkage during setting would facilitate the fitting of cast iron guides to the face of the dam for control sluices. Up to the present time precast concrete blocks have been used with successful results in building temporary cofferdams but there is no reason why concrete blocks should not be used for a large permanent dam

CONTRACTION JOINTS.

Sandeman.

The author suggests that joints in masonry dams should be referred to as "contraction joints" and not as "expansion joints" since they are designed to deal with contraction. It is unnecessary to provide for expansion as this simply compresses the masonry. He quotes a few examples of dams showing numerous cracks such as the Boonton Dam in U. S. A. and the Assouan Dam in Egypt. Some well known English dams however such as the Vyrnwy Dam and the Derwent dam have not developed cracks and the author suggests a method of construction to avoid cracks, based on experience with the English dams. His principal recommendations are :

(*a*) moderate speed in building;

(*b*) the use of as large proportion of stone as is possible in comparison to concrete.

(*c*) the use of less finely ground cement and the use of cement made to a specification limiting the rise of temperature in setting;

(*d*) aeration of cement before using;

(*e*) the use of as stiff a mix as possible without detriment to the workability.

He recommends a length of 25 to 30 ft. between joints. As regards joints, the type used recently in a dam in Londonderry where the face of one section is designed with a large projecting panel bevelled on all four sides which fits into a corresponding depression in the adjoining section is suggested as one of the simplest and most effective.

ALLUVIAL DEPOSITS IN RESERVOIRS, THEIR IMPORTANCE AND THE MEANS TO LESSEN OF PREVENT THEM.

Visentini.

"This report is a compendium of what is positively known up to date in Italy about alluvial deposits in reservoirs and the transport of solid material in the watercourses. It is only a collection of factual data and experimental findings without theories and laboratory researches on the question".

In discussing the most efficient remedies against the "solid snare" in reservoirs, the author classifies the Italian river valleys into three types depending on their geological formation and suggests measures to prevent erosion and the consequent transportation of solid matter into the reservoirs for each type of valley.

GROUTING OF MASONRY DAMS.

Derqui.

This article deals with the problem of waterproofing the main bodies of high masonry gravity dams in which there is percolation through the dam proper. Foundation seepage or leakages round abutments are not considered. The waterproofing operations consist of drilling a number of holes in the body of the dam and injecting grout under pressure into them. Location of holes, pressure to be used in injecting grout and similar questions of practical interest are discussed.

GEOLOGY OF RESERVOIR-DAM SITES.

Bromehead.

Discusses important features of strata of solid rock and drift deposits as affecting dams and reservoirs. The importance of a knowledge of local geology in fixing sites for dams and reservoirs is clearly brought out. Instances are mentioned of the useful assistance of the Geological Survey of Great Britain in fixing sites of dams.

SPECIAL CEMENT FOR LARGE DAMS.

Summaries of the following papers are given :—

1. Temperature effects in mass concrete—Davey. (See page 15 of Bulletin No. 5).
2. Special cement—Halcrow.

Data are given of temperature rise and crack formation of Laggan Dam. Methods and means of testing heat evolution and solubility of cements are described.

DESIGN AND WATERPROOFING OF SHRINKAGE, CONTRACTION AND EXPANSION JOINTS.

Summaries of the following papers are given :—

1. Shrinkage, Contraction and Expansion Joints in Norris Dam—Jones.
2. Keying Scheme for Arch Dams—Coyne (France)
3. Design and waterproofing of shrinkage, contraction and expansion joints in large dams —Link (Germany).
4. Construction Joints—Juillard (Switzerland).
5. Joints in Concrete Dams—Williamson (Great Britain).
6. Joints in Gravity Dams—Renaud (France).
7. Shrinkage, Contraction and Expansion Joints—Thimel (France).
8. Waterproofing of Expansion Joints with Rubber in Concrete Lining of a Supply Canal—Smrcek & Kalla (Czechoslovakia).

Summaries of the above papers have also appeared in other periodicals. See pages 20, 21, 50 and 146 of Bulletin No. 5.

STUDY OF THE FACING OF MASONRY AND CONCRETE DAMS.

Summaries of the following papers are given :—

1. Watertightness of the Body and of the Facing of Concrete Dams—Weigl (Austria).
2. Metal Facing of Masonry and Concrete Dams—Iwanow (Bulgaria).
3. Facing of Masonry and Concrete Dams.—Bolomey (Switzerland).
4. The Facing of Masonry and Concrete Dams—Lossmann and Petzny (Czechoslovakia).
5. Study of the Facing of Masonry and Concrete Dams—Binnie (Great Britain).
6. Use of Bituminous Materials in the Construction of High Dams—Glebov (U. S. S. R.)
7. Design and Behaviour of the Facing of Large Dams in Germany—Ludin (Germany).

Summaries of the above papers have also appeared in other publications, (See pages 21, 22 and 146 of Bulletin No. 5).

GEOLOGICAL AND GEOTECHNICAL STUDIES OF DAM SITES.

Summaries of the following papers are given :—

1. Determination of Depth of Bedrock—Sundberg (Sweden).
2. Geotechnical Studies of the Foundation Materials of Large Dams—Grischin (U. S. S. R.).
3. Geotechnical Studies of the Foundation Materials of Large Dams—Lugeon (Switzerland). (See pages 23 and 147 of Bulletin No. 5).

CALCULATION OF THE STABILITY OF EARTH DAMS.

Summaries of the following papers are given :—

1. Seismic Stability of the Earth Dam—Mononobe, Takata and Matumura (Japan).
2. Rolling the Soil in Earth Dams—Myslivec (Czechoslovakia).
3. Stability of Earth Dams in Cases of Reservoir Discharge —Mayer (France).
4. Problems Concerning Stability Calculation of Earth Dams on Movement and Action of Infiltration Water—Takata and Kambara (Japan).
5. Stability of Embankment Foundations—Gilboy (U. S. A.)
6. Stability of Earth Dams—Pagliaro (Italy). (See pages 23, 24, 147 and 148 of Bulletin No. 5).

SCHWEIZERISCHE BAUZEITUNG.

(In German.)

VOL. 113.

No. 13—March 31, 1934.

RECENT EXPERIMENTS ON SHINGLE MOVEMENT.

Meyer-Peter.
Favre.
Einstein.

Describes the results of experiments conducted at the Hydraulic Research Institute of E. T. H. on the movement of shingle of uniform size. Examines Schoklitsch formula, which sets forth that shingle movement is proportional q-qo where q is the actually measured discharge and qo the discharge that will correspond to the condition of equilibrium with the same slope but no shingle; and gives the authors' own formula $\frac{q^{\frac{2}{3}} J}{d} = 17 + \frac{0 \cdot 4Z^{\frac{2}{3}}}{d}$ where q is the discharge in Kg/Sec. m., z the shingle movement in Kg./sec. m., d the average diameter of the shingles and J the relative slope of the energy line. Compares both the formulas and gives reasons for justification of the authors' formula.

(Translation of the article is also available).

VIZUGYI KOZLEMENYEK.

(In Magyar but containing English summaries).

Vol. XVIII.

No. 4—October-December 1936.

THE VEGETATION OF ALKALI LANDS IN HUNGARY.

Fay.

The object of this article is to familiarize civil engineers working on reclaiming alkali soils with plants which give useful indications of the degree of alkalinity. The plants which are suitable for the afforestation of alkali lands are described and their characteristics are discussed.

A SHORT SUMMARY OF THE SCIENCE OF SOIL.

Endredy.

A comprehensive article on the science of soil covering general properties of soils and their examination. The composition of soil is described. Physical properties of soils such as coherence, shrinkage, plasticity are discussed. The behaviour of soil towards water is discussed. The second part of the article deals with the procedure of examining soils and interpretation of results of examination.

RECENT FEATURES OF CONCRETE MANUFACTURE.

Schwertner.

In this article are discussed the strength of concrete as influenced by the water cement ratio, the influence of temperature on the setting of concrete, natural cements as complementary materials. and vibration of concrete.

REVUE GENERALE DE L'HYDRAULIQUE.

(In French).

No. 15—May-June 1937.

FLUVIAL HYDRODYNAMICS—VARIABLE REGIMEN.

Cagniard.

In this article the author develops an application of Carson's method of integration to the study of the propagation of intumescences of low amplitude, downstream or upstream of a large river of which the initial regimen is permanent and uniform. This problem has previously been resolved by M. Deymie and discussed thoroughly by M. Masse. Nevertheless the exposition contained in this article offers a simplification of the discussion and further development of some points.

THE CATASTROPHIC FLOODS OF MARCH 1936 AND JANUARY-FEBRUARY 1937 IN THE UNITED STATES OF AMERICA.

Parde.

A concluding article by M. Parde, in which he traces the path of the floods from rainfall and describes the methods of gauging.

PEDOLOGY.

(In Russian)

No. 1—1936.

SHEARING STRENGTH OF SOILS.

Pigulevsky.

This article contains an English summary.

It gives an account of the experimental analysis of the shear process by means of a device developed by the author with the results obtained. The author has suggested a new formula for shear in loose and cohesive materials which he believes to be more accurate than other existing ones. His investigations contradict the statement of Terzaghi to the effect that the coefficient of friction of soil complexes increases with the decrease of normal load on the surface of shear.

STATISTICAL THEORY OF SOIL STRUCTURES.

Pikrovsky.

This article also contains an English summary. A statistical method for a quantitative description of the various structural types of soil which is being worked out by the author is described.

ULTRA POROSITY OF SOILS.

Dumansky.
Chapek.

This article also contains an English summary. Determination of ultraporosity of soils by the absorption of benzol vapours is described.

THE METHOD OF DETERMINING THE MAXIMUM HYGROSCOPIC WATER CONTENT IN SOIL.

Nicolaiev.

This also contains an English summary. A method for determining the maximum hygroscopic water content in soils by means of a saturated solution of potassium sulphate is described.

THE EVOLUTION OF THE CARBIDE METHOD FOR DETERMINATION OF SOIL MOISTURE.

Vadiunina.

This also contains an English summary. The short-comings of the carbide method of determining soil moisture are discussed.

THE INFLUENCE OF THE FORM AND SIZE OF IRRIGATED SQUARES ON THE PERMEABILITY OF THE SOIL.

Katchinsky.

This contains a German summary which is being translated.

AGRICULTURE AND LIVE-STOCK IN INDIA.

VOL. VII.

Part IV—July 1937.

ERADICATION OF CYNODON DACTYLON (HARIALIDOUB GRASS) BY TRACTOR PLOUGHING IN THE BOMBAY-KARNATAK.

Salimath.
Kulkarni.
Gayatonde.

This plant is a common grass much in favour as a horse feed and for lawns. In the field however it is a persistent and troublesome weed. Certain investigations were conducted in fields infested with this weed as regards the extent of its infestation, depth of runners and the effect of deep ploughing on the weed. The results are presented in this article and certain conclusions of practical value are drawn from the investigations.

'PAN-SUKH' DISEASE OF RICE IN THE CENTRAL PROVINCES. Dastur.

Describes a condition of rice known as "Pan-Sukh" disease in the Central Provinces. It is a physiological disease.

Part V—September 1937.

THE FOOT-HILLS GRAZING PROBLEM IN INDIA. Gorrie.

This article describes grazing conditions in the drier parts of Northern India comprising Punjab, North-West Frontier Province, Sind, the United Provinces and Central Provinces. In areas where the rainfall is not heavy grassland can only exist under reasonable treatment and if once destroyed cannot reinstate itself as easily as it can under a slightly heavier rainfall. Over very large tracts of the country grasslands have disappeared, and the last vestiges of shrub growth form the ordinary daily ration of the village herd. The result is heavy erosion in the foothills and a tremendous increase of run-off. The effect is only beginning to be realized in the recurring failure of the Punjab Canal systems to produce sufficient water for cold weather irrigation.

The author suggests a line of attack in dealing with overgrazing and other misuse of land which he describes in detail. His main idea is to develop fodder resources for local live stock and to improve the standard of cultivation in any way which will tend to conserve soil and reduce run-off. He also suggests reduction of surplus animals by a propaganda for fewer and better cattle.

THE QUALITY OF SUGARCANE IN NORTHERN INDIA IN RELATION TO BORER INFESTATION AND DISEASE INFECTION. Haldane.

During February 1937 a survey was made over the supplies of cane delivered to ten factories in United Provinces and North Bihar. The examination of the cane was made at the factories and every effort was made to make the survey representative of the areas of supply and the materials delivered. These investigations are described and the results for each factory are given. Conclusions arrived at as the result of the survey are detailed.

FURTHER WORK ON THE MANURING OF SUGARCANE IN NORTH BIHAR. **Cliff.**

Presents results of manurial trials on cane on the farms under the author's control indicating the value of a small dressing of superphosphate in conjunction with both farmyard manure and green manuring.

THE INDIAN JOURNAL OF AGRICULTURAL SCIENCE.

VOL. VII.

Part III—June 1937.

STUDIES IN *FUSARIUM* WILT OF SANN-HEMP. Uppal.
Kulkarni.

A destructive wilt disease has caused heavy reduction in the yield of Sann-hemp which is used as green manure in Bombay Deccan. This article gives a short account of the symptoms of the disease and the organism which causes it.

Part IV—August 1937.

STUDIES ON THE ROOT-ROT DISEASE OF COTTON IN THE PUNJAB. Vasudeva.

Discusses the effect of the following factors in influencing the incidence of the disease: irrigation, soil moisture, date of sowing, and sowing in ridged and flat rows. Certain experiments were carried out which are described with their results.

AIR SURVEY.

(Published by Indian Air Survey and Transport, Ltd., Dum-Dum).

This publication has been designed with the object of explaining and illustrating Air Survey methods. In recent years tremendous advances have been made in the technique of air survey. Air survey methods can guarantee accuracies up to 1 in 300 between points fixed on the ground. Scales from 1 inch to 12 inches to the mile can be prepared by graphical methods and larger scales can be prepared by particular use of the stereoscope. An important difference between a photograph and a map is that the photograph records everything seen by the eye of the camera while a map contains only those features which the surveyor considers of importance. Invaluable topographical information can be furnished by a photograph regarding forestry, the state of crops, extent of floods, archæological and geological indications, and river maps.

Some ground control methods in air survey and the use of the stereoscope are described. A few photographs as examples of air survey work are given and include an anaglyph of a part of Darbhanga (Bihar) after the earthquake of 1935, a town map, photograph of a paddy tract in Bengal, and photograph of a river channel.

CURRENT SCIENCE.

VOL. VI.

No. 1—July 1937.

SOIL FERTILITY AND THE ROLE OF TRACE ELEMENTS. Rao.

Recent investigations on soil fertility and the factors that influence plant growth have shown that some elements in the soil, needed only in very small quantities exercise marked influence on plant growth. Amongst these are manganese, bismuth, zinc, etc. These elements are sometimes present in such small quantities that ordinary laboratory methods may fail to detect their presence. Valuable information may be obtained by spectrographic examination of soils as it enables detection of all metallic elements contained in them without the chance of the rarest ones going undetected. Further experiments with this method are in progress.

IMPORTANT INSECT PESTS OF SUGARCANE IN THE BOMBAY PRESIDENCY. Deshpande.

This article gives all the available information about the major insect pests of sugarcane in Bombay Presidency and the control measures which have been tried and found useful.

AGRICULTURAL RESEARCH IN CHINA. Datta.

Describes agricultural research work being carried out in China at the present time. The researches are directed to crop improvement in regard to wheat, rice, cotton and potatoes. An important investigation with rice concerns the effect of the length of exposure to daylight on different varieties of rice. A shortening-day treatment will make the early, medium, and late varieties flower at the same time. Other investigation include farmyard manure and fertilizer tests, forestry research, and silkworm research.

No. 2—August 1937.

SCIENCE NOTES.

A 25 square mile tract can be "picked up" from an airplane and set down on a table top in three dimensions by means of an instrument known as a multiplex projector now being built for the U. S. Army Corps. An airplane working in conjunction with the aero-projector flies over the area, and an automatic camera takes a film of the area. The film is developed and printed on glass plates which are used as lantern slides for a battery of projectors. The images formed by adjacent projectors on the table overlap just as the areas covered in successive photographs do. Alternate projectors form their images in red and green light. The user wearing spectacles with one lens red and the other green sees the overlapped area stereoscopically.

No. 3—September 1937.

Nothing of interest to irrigation engineers in this issue.

GLEANINGS FROM HERE AND THERE.

(Issued by the Associated Cement Companies, Ltd., Bombay.)

No. 3.

There is nothing of interest to irrigation engineers in this.

INDIAN AND EASTERN ENGINEER.

VOL. LXXXI.

No. 1—July 1937.

VENTILATION WITH AIR CONDITIONING IN MODERN BUILDINGS. Dolby.

Defines air conditioning and discusses the basic principles involved. Mechanical means for air conditioning are described and examples of some actual installations are given with illustrations.

LONG RANGE EXCAVATING. PART II. THE SLACKLINE CABLEWAY. Taylor.

The slackline cableway is a feature of a type of scraper used where the excavated material has to be lifted an appreciable height, where it has to be handled over long distances, or where there is a combination of the two conditions. The operation of this type of ensemble is described with reference to the construction of a reservoir and cleaning out rivers. A typical installation is described and illustrated.

INFLUENCE OF TEMPERATURE ON THE STRENGTH OF CONCRETE. Davey.

Gives results of a large number of experiments made at the Building Research Station on the crushing strength of concrete with several types of cement at different temperatures.

No. 2—August 1937

REINFORCEMENT PRE-FORMING MACHINES.

An automatic portable machine for bending reinforcement bars to any desired shape is illustrated.

PENETRATION OF MOISTURE IN MASONRY WALLS.

Rates of penetration of moisture through walls of brick masonry are being measured by the U. S. A. National Bureau of Standards to determine what combinations of materials and types of construction are most resistant to leakage when exposed to rainfall. The results of the tests carried out so far indicate that the quality of workmanship and the thickness of the walls have a major influence on the rate of penetration of water.

No. 3—September 1937.

THE PYKARA HYDRO-ELECTRIC DEVELOPMENT SCHEME —SECOND STAGE.

The second stage of this scheme comprises the Mukurti Dam which is now under construction, and will soon be completed. It is an arched masonry dam 520 ft. long with a maximum height of 90 ft. above the river bed. There is a controlled weir section 160 ft. long on the left flank. The dam is built of random rubble masonry in cement mortar with coursed rubble facing. Impervious mortar was used for the upstream face for a thickness of 5 ft. from the top face and 12 ft. from the bottom face. Holes were drilled on the upstream two-thirds of the width of the foundations at 15 ft. apart and were grouted under pressure with a view to seal the rock. Power house plant and other features of the project are described.

HYDRAULIC FLOW FORMULAE. CORELATION BY THE NEW ENERGY THEORY. Blench.

In this article it has been shown that the same form of resistance law and energy dissipation law underlies turbulent flow whatever be the nature of the boundary; and that the various authoritative flow formulæ can all be derived from exactly the same form of resistance law, and are capable of being expressed in one form. The energy theory is outlined and an energy equation true for both pipes and channels is derived. The physical meaning of Mr. Gerald Lacey's $\frac{V^2}{R}$ is discussed and it is shown that this expression is a measure of the resistance per lb. to eddy motion from boundary to surface.

WATERPROOF PAPER AS INSULATION BETWEEN SUB-SOIL AND CONCRETE.

The use of waterproof paper for insulating new concrete from the sub-soil in road construction is becoming almost standard practice in Great Britain. Sub-soil characteristics which call for the employment of a strong waterproof building paper are porosity and contamination. Their effect on concrete is discussed and the advantages of using a waterproof paper as insulation between sub-soil and concrete are explained.

THE INDIAN CONCRETE JOURNAL.

VOL. XI.

No. 7—July 1937.

NEWS & NOTES.

SPRAYING FIREPROOF CEMENT.

The spraying of paint, distemper, etc., has been common practice for a number of years but now the spraying of cement is coming into use. A particularly useful application is in connection with the refractory lining of certain types of furnaces. To cover the firebrick walls with a smooth lining, a high pressure cement gun sprays the cement on the surface, producing a perfect coating which penetrates more efficiently into the interstices of the bricks.

THE FRANKLIN MOVING SYSTEM OF CONCRETE WALL CONSTRUCTION.

A number of moveable forms of lightweight metal construction is used in this system. A form is placed in position, filled with a dry mix of concrete and is well tamped. The forms are moved to the next adjacent position as soon as tamping is finished and the process is repeated. A complete set of forms is available for an ordinary dwelling house and 120 cu. ft. of concrete can be laid in one day. A 1 to 8 mix is generally employed. Three men are sufficient to carry on the work.

No. 8—August 1937.

NEWS & NOTES.

ELECTRIC CURING OF CONCRETE.

The process of hardening of newly poured concrete is greatly accelerated by the heating effect of a low voltage current passed through the concrete between suitable electrodes Alternating current is used to prevent electrolysis. This method of curing has been largely applied in Russia. Tests indicate that electric curing of freshly cast concrete cubes for 24 hours results in the strength of the material being 95 p.c. of the 28th day strength of untreated concrete.

OBSERVATIONS ON THE INDIAN RAILWAY CODE OF PRACTICE FOR REINFORCED CONCRETE CONSTRUCTION.

Desai.
Shahani.

This paper is a sequel to two others published in the Indian Concrete Journal in July 1936 and April 1937 and aims at providing an easy method of designing reinforced concrete structures. Improved materials and methods of working make it possible to allow higher stresses than those hitherto allowed. The Indian Railways have accordingly adopted a new Code with increased permissible stresses. The authors have prepared a number of charts which accompany this paper and are useful for designing reinforced concrete slabs and beams in accordance with the new code. The charts save laborious calculations and time. The equations which form the basis of the charts have been worked out by standard methods, and practical examples illustrating the use of the charts are given.

CONCRETE PILE DRIVING. McCarthy.

Discusses factors which should be taken into consideration in concrete pile driving. The causes of damage to concrete under severe driving conditions are discussed, and the precautions to be taken are indicated. Test piles, test loading of piles and settlement of piles are discussed, and from amongst the many pile driving formulæ in use, the Hiley formula is considered the only one which is theoretically sound.

VIBRATION FOR CONCRETE ROAD CONSTRUCTION.

Describes a new type of machine for vibrating concrete in road construction. It is called a pervibrating machine, the term pervibrating being used to indicate internal vibration as distinguished from surface vibration.

LARGE SCALE VIBRATION OF CONCRETE.

Dixon.

A brief description is given of a mechanical vibrating apparatus specially constructed for the slopes of the inlet canal of the Champaubert reservoir in France. The total length of the canal is 3 miles, and it has a bed width of 13 ft., a depth of 6 ft. and a top width of 34 ft. The concrete is 6 inches in thickness.

No. 9—September 1937.

NEWS & NOTES.

EUROPE'S LARGEST CONCRETE BUILDING.

This is the new exhibition building at Earl's Court, London. The structure which is entirely of reinforced concrete covers an area of 9 acres. The roof over the central arena has a span of 350 ft. by 250 ft. without intervening columns and is 120 ft. above ground floor level.

THREE-SPAN REINFORCED CONCRETE BRIDGE DESIGN IN THE ISLE OF ELY. Hill.

The old bridges over main drains in the Isle of Ely are being replaced as they are unsuited to modern traffic. Various types of 3-span bridges have been designed and these articles deal with the design of the three following types.

1. Continuous three-span.
2. Three-span with cantilevers and suspended slab centre span.
3. Continuous centre span with end cantilevers.

This is the first article of the series and deals with the continuous three-span type. Details of calculations are given.

NEW TENDENCIES IN CONCRETE ROAD CONSTRUCTION. Quennessen.

Describes new developments in road construction methods in France.

NOTES ON VIBRATED CONCRETE.

Discusses the advantages of vibration and its effects on the concrete. Speed of vibration, grading as related to vibration, extra material required for vibrated concrete, and effect of vibration on cost are some of the other points which are discussed. The requirements for satisfactory vibration have been laid down and it is pointed out that vibration can do more harm than good if it is not properly used.

CURING CONCRETE ROADS AND FLOORS.

Satisfactory results are claimed for a product called "Sisalkraft" which can be used in covering up newly laid concrete to prevent evaporation and help in curing the concrete. The method generally used now is to cover the wet concrete with a deep layer of sand kept wet by sprinkling with water. If "Sisalkraft" is spread on the concrete the evaporation is practically suspended. It is a type of fabric obtainable in rolls and the same piece can be used several times on different surfaces without fear of fracture.

INDIAN ENGINEERING.

VOL. CII.

No. 1—July 1937.

REINFORCED BRICKWORK. Vasudevan.

Contains a discussion of the theory of design of reinforced brickwork and a practical method of designing reinforced brickwork structures. A few actual examples have been worked out and the advantages of reinforced brickwork construction are given.

U. P. HYDRO-ELECTRIC GRID, STATE TUBE WELL SYSTEM.

The hydro-electric scheme comprises six power stations on the Ganges Canal in operation and a seventh under construction. A steam driven station has also been constructed to carry peak loads during the irrigation season. About 1,300 tube wells are in operation out of the total projected number of 1,500. Each tube well commands about 1,200 acres and is designed to irrigate 240 acres of rabi, 125 acres of sugarcane and 60 acres of other kharif crops. Total area to be irrigated by tube wells is estimated to be 625,000 acres out of a total commanded area of 1,750,000 acres.

KHYBER AGENCY IRRIGATION.

A scheme consisting of a dam across the Khyber river at the point where it debouches from the hills was recently investigated from the geological point of view. The object of this proposed scheme was to irrigate land in the Khyber Agency. The main features of the scheme and the geology of the various sites proposed and examined are discussed. The scheme has been shelved for the present for financial reasons.

FRENCH ENGINEERING ACHIEVEMENTS.

A general description is given of some of the outstanding engineering works in France during recent years. These include the Elorn bridge, a reinforced concrete arch bridge with three spans of 610 feet, each carrying a double deck, the upper one for the highway and the lower one for the railroad. Each arch is composed of two hollow arcs of rectangular cross section. The design is due to M. Frayssinet, the celebrated French engineer.

Hydro-electric schemes have been greatly developed in France in recent years. Some of the dams are described. The Chambon Dam is a gravity dam, 960 ft. long, and 445 ft. high, and is next only to the Boulder Dam in height. A few other dams are described and mention is made of some of the difficulties encountered and solutions adopted.

Another important work is the Rove canal tunnel. The Rove canal connects the port of Marseilles with the river Rhone and passes through a rocky barrier separating the two water levels. The canal passes through a tunnel in the rock for a distance of 4·6 miles and is 72 ft. wide with a depth of water of 13 ft. This is the largest underground canal in the world.

SUPPLEMENT TO "INDIAN ENGINEERING", JULY 1937.

This Supplement gives a new schedule of rates of building and engineering works within and outside Calcutta and the Bengal Presidency.

No. 2—August 1937.

LETTERS TO THE EDITOR.

LIMITING REGIME DISCHARGES.

Mr. Gerald Lacey in this letter refers to an article published in the June number of Indian Engineering (See page 66 of Bulletin No. 6) and says that the subject could be dealt with in a simpler manner. He also refers to certain equations derived in the original papers and points out that some of them are incorrect. He discusses the question of minimum stable perimeter in channels in incoherent alluvium, and the bed width : depth relationship of small and large channels. He expresses his agreement with the view of the author of the original article that the laws of discharges below the limiting regime discharges are different.

BUTTRESSED DAMS : MODERN DEVELOPMENT : FEATURES OF THE AMBURSEN SYSTEM OF CONSTRUCTION.

Lewis.

The essential features of a new type of buttressed dam construction patented in the U. S. A. are described. This type of dam is called the Ambursen Dam and is of reinforced concrete construction and it contains about 40 per cent. less material than a corresponding mass dam. There are two types of buttressed dams, one with massive buttresses, and the other with thin ones. The two types are compared and the thin buttress type is said to be the more favoured type. The Ambursen dam is also of thin buttress type. The buttress dam is compared with the gravity dam and the advantages and disadvantages of each are discussed. Some examples of recent construction of this type of dam are given.

PUMPING SANDY WATER.

A centrifugal pump installation is being operated in England by a waterworks Company which is pumping water containing sand without any serious trouble.

UHL RIVER WATER POWER UNDERTAKING.

Features of the Mandi Hydro-electric Scheme in the Punjab are described in this article. (See page 121 of Bulletin No. 5).

No. 3—September 1937.

NOTES AND COMMENTS.

MALAKAND HYDRO-ELECTRIC PROJECT.

Describes the main features of the above project which is under construction in the North-Western Frontier Province. In the first stage, the power generated will be 20,000 k.w. and the cost will be Rs. 7½ lacs.

CURRENT NEWS.

Mr. T. M. Lyle, Chief Engineer, U. P., recently toured the flood-stricken areas of the Eastern Districts of U. P. He has drawn up a detailed plan which if carried out will minimise damage from floods in future. A number of projects are under consideration in this connection.

LETTERS TO THE EDITOR.

LIMITING REGIME DISCHARGES.

Mr. Khushalani, the writer of the original paper replies to Mr. Gerald Lacey's comments on his article.

ROLLING THEORY OF WATER. Khushalani.

In this article the author puts forward a new theory of movement of water. According to him, there is no streamline motion of flowing water but what actually happens is that water rolls along, the particles describing vertical cycloidal curves alternately touching the bed and the surface. That the assumption of rolling action does not affect the Chezy formula has been proved by the author. The author has advanced a formula $V=m\sqrt{fZ}$ where V is the velocity, m is a constant. f is the silt factor and Z the lever arm of the couple causing the rolling action. He refers to Mr. Gerald Lacey's paper on "Stable Channels in Alluvium" wherein he advocates the use of R the hydraulic mean radius for calculating critical velocities and proceeds to show that hydraulic mean radius could not be a criterion for velocity. He has applied Mr. Lacey's results to some types of sections and argues that certain inconsistent conditions arise while with the writer's lever arm theory these conditions can be rationally explained. His contention is that while Mr. Lacey's formulæ do not stand mathematical tests, his own formula does. He also shows that his formula fits in with observed data as well, and offers an explanation as to why Mr. Lacey's theory, though mathematically inconsistent, agrees so well with observed data.

INDIAN ROADS.

No. XI—June 1937.

THE MINISTRY OF TRANSPORT EXPERIMENTAL ROAD.

The first set of experiments was directed to the determination of the effect of various factors in the design of concrete roads and to investigate the effect of weather and traffic on the behaviour of concrete road slabs. The various factors considered were thickness of concrete slab, water cement ratio, effect of steel reinforcements in slabs, and the use of different lengths of slabs. Some of the conclusions arrived at in respect of the above factors are set forth. Other investigations included measurement of temperatures at the top and bottom of the slab, observation of curling of slab due to temperature changes, and abrasion of cement by traffic. Observations were also made on the deflection of the slab. Results of observations are given.

THE PERMEABILITY OF PAVEMENTS.

This article contains brief descriptions of some types of apparatus used to determine whether a road surface is impervious, and if not, the rate at which water passes through the surface.

CONCRETE PAVEMENT FAILURES DUE TO HIGH-LIME CEMENT. Paul.

The author discusses some cases of pavement failures in New York state which are due to the use of cements with high lime contents. In conclusion he says that the question of increasing the life of concrete roads can be solved through the production of low-lime cements.

FATIGUE OF CONCRETE.

Considerable research has been done on the fatigue behaviour of concrete or its action under repetitions of stress. Main conclusions of these researches are given and a graph is reproduced showing the fatigue behaviour of concrete in flexure.

DEMONSTRATION ASCU TREATED TIMBER HIGHWAY BRIDGE AT LUCKNOW EXHIBITION.

This highway bridge was designed and built by the Forest Research Institute, Dehra Dun, to demonstrate the utility and economy of treated wood for bridges. The span is 48 ft. and the bridge is capable of carrying a ten ton steam roller and a crowd of people. A service of 30 years may be expected from this type of bridge.

EXTRACTS.

Under this head are included abstracts of literature on highway engineering from various countries. Some of these may be mentioned.

1. Contributions to the experimental study of cement bound macadam roads.
2. Apparatus for measuring the stresses in concrete slabs.
3. Cracks and sinks in concrete.
4. New road surfacings in reinforced concrete.
5. Frequent and avoidable faults in concrete road construction.
6. Soil stabilization work in Jackson County. Stabilization methods for earth tracks are described.
7. Russian experimental tarred earth roads. Stabilization of earth roads in heavy loam soils with tar is described.
8. Brick road paving.

SCIENCE AND CULTURE.

VOL. II.

No. 9—March 1937.

SOME PLANT DISEASES AND PESTS OF INDIA AND THEIR CONTROL. Mitra.

Continued from previous issue. Some diseases of cereals, sugarcane, fibre crop, pulse crop, oil seeds, spice crops, fruit trees and forest trees are described, with remedies for their control.

VOL. 3.

No. 1—July 1937.

VERNALIZATION—A NEW RUSSIAN METHOD OF CROP PRODUCTION. Mitra.

The most remarkable achievement in agriculture during recent years has been the Russian discovery that by suitable treatment of the seeds before sowing crop production can be greatly hastened. This process was discovered about 1928 and is known as vernalization. The precise method of vernalization varies with different plants. The process applied to winter wheat is as below. Winter wheat seeds are first soaked in water, the weight of the absorbed water being limited to 50 per cent. of the dry weight of the seed. The seeds are kept in water for one or two days at room temperature when they get swollen and embryos begin to emerge from the seed coat. They are then kept in darkness at a temperature of 85-86°F. for 40 to 50 days. After this period the process of vernalization is complete and the seeds are ready for sowing. The vernalized seeds are outwardly quite similar to the un-vernalized ones, but differ in quality. The practical utility of vernalization is the possibility of obtaining two crops in one season. In Russia, the unvernalized winter wheat takes 92 days from the date of sowing to earing while the vernalized crop takes only 54 days. The yield has also been found to be much greater, and other qualities such as drought resistance, size, quality, and weight of the grains are also increased. In India however, results of tests on vernalization have not been promising so far. Probably the Indian forms require different sets of conditions, and further research work is needed to determine these. The Indian varieties have however yielded encouraging results at the hands of Russians.

No. 2—August 1937.

NOTES AND NEWS.

THE CONTROL OF RAGING WATERS.

The editor comments on the ravages and destruction caused by floods in American rivers. Bank erosion became a serious menance until a new method of bank protection was developed, which consists of a solid concrete dyke facing. The editor says that conditions in Bengal are the same as in America, and a wise and comprehensive planning on a scientific basis is required in Bengal to cope with the problem of its rivers.

INDIAN SCIENCE CONGRESS—DISCUSSIONS.

Gives the discussions which have been tentatively arranged for the Jubilee meeting of the Indian Science Congress. Under the section of Mathematics and Physics will be discussed the subject of River Physics in India.

IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

ANNUAL REPORT.

The editor reviews the annual report of the Imperial Council of Agricultural Research for the year 1936-37. Research schemes financed by the Council form a considerable part of the report. The research work carried out at the various research stations all over India subsidized by the Council deals mainly with breeding and cultivation of rice, sugarcane breeding, means of fighting insect pests, and rust research. An increasing amount of attention is being given year by year to fruit research.

No. 3—September 1937.

PROBLEMS OF RIVER PHYSICS AND HOW THEY ARE SOLVED.

Bose.

In modern times knowledge of science is being applied to almost all forms of human activity, and river engineering science has developed to a remarkable extent during recent years. It has been found that laws of river physics can be as effectively studied in the laboratory as those of stellar physics in a physicist's laboratory. The author then proceeds to explain how a river model is constructed in a laboratory and the procedure of fixing the scale ratios. He explains Reynold's number in relation to turbulent and laminar flow and shows that unless the vertical scale is suitably exaggerated, a very small depth will be obtained in the model and the Reynold's number will be very small so that the flow will not be turbulent as in the actual river. With a small depth in the model the velocity will not be sufficient to move the silt in the bed of the model. He then discusses how it is possible to reproduce silt movement correctly in the model. The selection of discharge scale and time scale is then explained.

IRRIGATION IN INDIA.

Review of Central Board of Irrigation Publication No. 14, the Annual Report (Technical) of the Board for the year 1935-36. In commenting on the Hardinge Bridge experiments carried out at Khadakvasla, the editor says that the Ganges is the main flood carrier in Bengal but most of the flood water passes through the eastern arm of the Ganges which lies in Eastern Bengal, causing widespread erosion while Central Bengal is a land of dead rivers. If some of the water in the eastern arm of the Ganges known as the Padma could be diverted through certain spill channels which formerly used to distribute the Ganges spill over Central Bengal, a permanent solution might be found for the Hardinge bridge and Central Bengal would have benefited enormously.

The Sara Bridge was constructed at the insistence of the Bengal Chamber of Commerce on a site which was condemned by the Investigating Engineer, Sir Francis Spring, who also drew the attention of Government to the necessity of investigating river problems in a properly organized river physics laboratory before any large engineering work is taken in hand.

REVISTA DE LA SOCIEDAD CUBANA DE INGENIEROS.

(In Spanish.)

VOL. XXX

No. 6—June 1937.

THE ABUNDANCE OF TECHNICAL LITERATURE AND THE CONVENIENCE OF ITS CLASSIFICATION.

Editorial notes.

No. 7—July 1937.

No. 8—August 1937.

These contain nothing of interest to irrigation engineers

IRRIGACION EN MEXICO.

(In Spanish.)

VOL. XIV.

Combined Nos. 1, 2 and 3—January—March 1937.

ORGANIZATION AND FUNCTIONS OF THE NATIONAL COMMISSION OF IRRIGATION.

THE HYDROMETRY SERVICE OF THE NATIONAL COMMISSION OF IRRIGATION. Alfonso de La O.

This article describes the various gauging stations and the methods employed.

PRELIMINARY STUDY OF AGRO-ECONOMICS. Bernabe Pena.

CONCRETE PROPORTIONS. Federico Barona.

An article on investigations carried at the Bureau of Reclamation Laboratory at Denver, Colorado, U. S. A.

HELICAL TURBINES.

HELICOIDAL PUMPS.

AGRICULTURAL ENGINEERING.

VOL. 17.

No. 9—September 1936.

WATERSHED AND HYDROLOGIC STUDIES IN SOIL CONSERVATION. Ramser.

The Soil Conservation Service, U. S. Deptt. of Agriculture are to conduct studies of the effect of erosion control practices on conservation of water and control of floods. Reasons justifying the need of these studies are discussed. They are also to conduct hydrologic studies of rainfall and run-off for use in the economic design of erosion and flood control structures. The problem consists of a detailed and comprehensive study of the action of water from the time it reaches the surface soil until it leaves the watershed as surface or ground flow. It will include studies of precipitation, percolation, co-operation, transpiration, surface and underground storage and rate of movement over the ground surface and through stream channels. The general plan of study is described and the field procedure is outlined.

APPLICATION OF RAINFALL INTENSITY-FREQUENCY DATA. Yarnell.

A bulletin of the U. S. Deptt. of Agriculture entitled "Rainfall, intensity-frequency data" gives a rational formula for the computation of run-off from rainfall intensity-frequency data. Certain factors which have not been fully covered in the bulletin are discussed in this article.

NEW DEVELOPMENTS IN TERRACING IN THE SOUTH-EAST. Nichols.

Terracing as an erosion control measure as practiced in the South-east of U. S. A. is described in this article.

AGRICULTURAL ENGINEERING DIGEST.

Current literature on Agricultural Engineering and other connected subjects is reviewed under this section. The following papers amongst others are mentioned :—

1. "A formula for capacities of reservoirs" by G. C. Dobson. Soil conservation U. S. (1) 1936. A formula is described which was developed for computing original and present capacities and silt volumes in storage reservoirs.

2. "Recent results of engineering experiments in soil and water conservation at the soil erosion experiment station, Tyler, Texas" by R. W. Baird. Proceedings of the Southwest Soil and Water Conservation Conference, Tyler, Texas, 1935. Data on run-off and soil losses from field areas with different characteristics and from different types of terraces, on erosion control in terrace outlet ditches and gullies, and on the use of farm machinery on terraced land, are summarized.

JOURNAL OF THE ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.

Vol. XIX.

No. 2—May 1936.

This issue of the journal contains proceedings of the fifty-first annual convention of the Association held at Washington in November 1935 and the papers contributed to the convention. The "proceedings" section contains the following reports :—

Report on soils and liming materials.

Reports on hydrogen-ion concentration of acid and alkali soils.

These reports deal mainly with determination of pH values of soils and the use of different types of electrodes for this determination. Some of the reports deal with the analysis of fertilizers of various sorts.

THE AMERICAN CITY.

Vol. LII.

No. 7—July 1937.

LEAD AS SHOCK ABSORBER ON SEATTLE BRIDGE.

Sheet lead has been used to reduce vibration in a bridge in Washington. The bridge is constructed of precast and precured concrete slabs resting on horizontal steel girders. The slabs weigh about 2 tons each, and are bolt anchored to the steel understructure. Sheet lead plates were laid over the entire area between the concrete slabs and the steel girders. In addition to its role as shock absorber the layer of lead takes up any differences in the surface of the steel and concrete permitting a perfect settling of the two materials and compensating for surface irregularities. Cracking of the slab under concentrated load is also prevented.

CHEMICAL ABSTRACTS.

Vol. 30.

No. 19—October 10, 1936.

(A key to the world's chemical literature, published fortnightly by the American Chemical Society.)

Under the section of soils, fertilizers and agricultural poisons, the following publication is mentioned among others :—

"The evaluation of irrigation waters" by Varallyay and Fejer.

For quick evaluation of irrigation waters, the detection of dry matter content, alkalinity, total hardness, and soda content is needed. Waters can be used for irrigation if their content of dry matter is below 500 mg./l and they contain no soda. Methods are proposed for the detection of these data.

Under the section "cement and other building material" the following publications are given.

1. Acid resistant cement and their chief properties.
2. A quick analysis of cement.
3. White cement.
4. Tar as road material.
5. Concretes.
6. Revetment mats for protecting river banks.
7. Solidifying pervious subsoil layers.
8. Compositions for filling cracks in concrete.

The water, sewage and sanitation section mentions the following.

1. Study of the water and silt of the Nile.

CIVIL ENGINEERING (NEW YORK).

VOL. 7.

No. 6—June 1937.

THE MISSISSIPPI MEETS THE 1937 FLOOD. Clemens.

In January 1937 a superflood which had reached record heights in the Ohio River rushed on to the Mississippi. People watched with anxiety the effect of this flood on the recently completed Jadwin flood control plan. The Jadwin plan was supplemented by a system of cut-offs constructed at the instance of General Ferguson, the President of the Mississippi River Commission since 1932. The well-nigh perfect functioning of the levee system, the floodways and the cut-offs was a thorough justification of the protective methods now employed for the Mississippi River. The 12 cut-offs completed have shortened the length of the Mississippi River by about 100 miles.

The city of Cairo is situated at the junction of the Ohio and Mississippi Rivers and the levees protecting the city were raised and strengthened to withstand a flood stage of 60 ft. The New Madrid Floodway was designed to reduce flood stages in Cairo and the fuse plug levee at the head of the floodway was blown up with dynamite to pass a portion of the flood in the floodway. This saved the city from being flooded. Below Cairo on the Mississippi River, flood stages were higher for about 200 miles than ever before but the raised and strengthened levees held the flood waters in control. In the lower reaches of the Mississippi, stages were much less due to the functioning of the cut-offs and improvements in river channel. At the mouth of the river, the Bonnet Carre spillway was opened to save the city of New Orleans which otherwise would have been under water. A table giving the stages and estimated flood flows at different points along the river shows that the 1937 flood established record heights in a reach of 300 miles below Cairo.

GEOLOGY OF DAM SITES IN SHALE AND EARTH. Mead.

Properties of shale, gravel, sand, silt and clay as foundations for masonry and earth dams are discussed in this article. The term shale is used to denote all fine grained sedimentary rocks originally deposited as clay or mud and compacted by natural process at a later stage. Distinction is made between compaction shales which have been consolidated by compaction alone and cemented shales which have undergone a cementation or setting process. Compaction shales are plastic and disaggregate in water. They may appear adequately strong in the dry condition but will slake disastrously under the action of water. Cemented shales are much more reliable. The bearing strength and elasticity of the two forms of shales and their behaviour under load are discussed. Precautions necessary in preparing shale foundations for concrete are set forth.

The treatment of earth dam foundations consisting of boulder deposits, gravel, sand or mixtures of these materials involves only the question of control of leakage through the foundations. This type of materials calls for thorough field and laboratory investigations of its permeability. River deposited silt is laid down with a high percentage of voids and is susceptible of compaction under load of the dam provided there is adequate opportunity for escape of water. If the load however is applied too rapidly there is tendency for the silt to flow from under the load. Clay is plastic and has the properties of a viscous fluid, having little bearing strength unless adequately restrained on all sides. It is incapable of supporting more than very moderate loads.

THE MODERN TREND IN BRIDGE DESIGN. Ogden.

Discusses modern types of steel deck type bridges which are a marked improvement over the old truss types. Improved materials, electric welding, use of beams instead of trusses, ingenuity in selecting types suited to different conditions, and increased attention to esthetic treatment have all contributed to the improved types of modern bridges.

FLOOD CONTROL AT CHATTANOOGA. **Chandler.**

This article describes the development of the flood control plan shortly to be started for Chattanooga District on the Tennessee River. The works consist of levees, cut-off channels, storm sewers, and flood gates. The physical features of the watershed are described and the problems that were presented in evolving a flood control plan are discussed.

ENGINEER'S NOTEBOOK.

HYDRAULIC MODELS USED IN DESIGN OF PARKER DAM. **Perliter.**

In the design of Parker Dam, hydraulic models were called upon to solve a variety of problems including the selection of the best type of dam, arch or gravity, the determination of the proper shape of the overflow crest, the most desirable operating conditions, and the best shape for the entrance approach to the gates. The model was constructed on a scale of 1 ·80.

Various crest profiles experimented upon are depicted and finally a profile with a steep slope was found to give the minimum action downstream. One gravity dam model and two arch dam models were tested with different types of crests and finally the arch dam with a sloping crest was selected as being the most economical.

THE WORK OF THE BRITISH STEEL STRUCTURES RESEARCH COMMITTEE. Fleming.

The British Steel Structures Research Committee was appointed in 1929 to review present methods and regulations for the design of steel structures, to investigate the application of the modern theory of structures to design, and to recommend the translation into practice of such results as would lead to more efficient and economical design. Three reports issued by the Committee are reviewed briefly in this article. The items considered in the reports are loads on floors, strains in buildings, stress analysis, specifications and properties of materials, welded connections, and vibration. Recommended rules of design with regard to loads, stresses, and other factors are given.

No. 7—July 1937.

RECTIFICATION OF THE RIO GRANDE. **Lawson.**

The Rio Grande River constitutes the boundary between the United States and Mexico for a distance of nearly 1,300 miles. Owing to characteristic changes in the channel of the river such as erosion and avulsion, and increased flood hazard in certain sections of the river valley it was decided that the International Boundary Commission should conduct studies relating to the defining of the land and water boundary between the United States and Mexico, to flood control, conservation and utilization of water, channel rectification and stabilization, and to other related matters. This article describes the projects evolved as a result of these studies. The rectification project for the upper reach of the Rio Grande includes the construction of the Caballo Dam which is a flood detention dam, and straightening of the river channel between levees in a length of nearly a hundred miles. This project was started in 1933 and is nearly completed. The lower Rio Grande Flood Control project includes the following features: raising and strengthening about 300 miles of River and floodway levees, clearing about 150 miles of floodways, construction of protective works to prevent flood damage to irrigation structures crossing the floodways, and construction of structures to control distribution of flood waters between the floodways. The river and other surveys now in hand are briefly described. The collection of hydrographic data is an important part of the investigations being carried out.

IRRIGATION FROM PUMPED WELLS. Holbrook.

Well water has a number of advantages over surface supplies for irrigation, among them being its relative invariability in quantity and less wastage. Well irrigation was not in general use in the U. S. A. at the beginning of the present century but it was a common practice in older countries. In India for example, 850,000 pumps were being used in 3 Provinces alone to irrigate 4,000,000 acres of land from wells. In U. S. A. large scale practice of well irrigation began about 30 years ago. Groundwater in large quantities may be present in the refill of broad stream valleys and in beds of sand and gravel in inland basins. These are the sources more commonly exploited in the U. S. A. The various types of wells which are suitable for different conditions of occurrence of ground water are discussed. In artesian areas the wells are of small diameter and are encased from the top of the ground to the pressure stratum. The rotary drill is used in drilling deep wells. If the water is in shallow deposits, a large diameter well is necessary or the area is covered with a number of wells of small diameter all connected with a central pumping pit. The different types of pumps suitable for different conditions are mentioned. The most widely preferred type for general use is the vertical turbine pump. Pumping costs are discussed.

GROUND AND SURFACE WATER PROBLEMS WITH PARTICULAR REFERENCE TO THE DEVELOPMENT OF WATER RESOURCES IN TEXAS.

Turner.

Groundwater is one of the principal natural resources of Texas. In recent years these resources have been taxed to the limit in many localities with the increasing development of the State. An investigation has been started to obtain accurate information regarding the quantity of groundwater in the various sections and to evolve the most effective measures for utilizing and conserving these resources. The lines on which these investigations are being carried out are described. Two factors which limit the amount of groundwater to be withdrawn safely from a stratum are :—the average annual recharge to the stratum, and the capacity of the stratum to transmit the water to the pumped area. Three quantitative methods are used in determining the safe limits of ground water withdrawal. These are called the recharge method, the transmission method, and the discharge method. These methods are described. In some parts of the country beds containing highly mineralized water overlie the sands containing fresh water. The mineralized water is likely to corrode the well casing and enter the well. Methods used in detecting the location of salt water leaks are described. A special electrical apparatus is used for the purpose. Other special cases to be tackled are salt water encroachment from the gulf and leakage of water from artesian strata resulting in waterlogging of certain areas. Such leaks are detected by deep well current meters.

ORGANIZING FOR WATERSHED DEVELOPMENT.

Forrest.

Describes the policy of development of watersheds on an organized basis as adopted in Texas. As an instance of the objectives of watershed development in the State the following programme for a particular area is given : Soil and water conservation : embraces land use survey, strip cropping, contour furrowing, terracing, check dams, and reservoirs. Drainage and flood control : embraces levees, ditching, and channel rectification. Submarginal land retirement : embraces reforestation and provision of grazing land.

The programmes are being carried out from State and Federal funds.

THE NEW GALVESTON CAUSEWAY.

Bartlett.

Describes a new causeway under construction across Galveston Bay in U. S. A. The main structure consists of continuous reinforced concrete girders with integral deck slab.

The girders are continuous in sections covering three spans 201·5 ft. between the through expansion joints. There is a drawspan with flanking spans occupying 276 ft. and the spans next to the abutments are 30 ft. each. The total length of the structure is 8,194 ft. The piers consist of two cylinders stiffened by a strut and by the rigid frame composed of the two cylindrical posts with the connecting cross girder below the decking. This open type of pillar construction is a special feature. The pier cylinders rest on caissons some of which down to a depth of 36 ft. and resting on 16 to 19 piles. The concrete pier cylinders are reinforced.

Irrigation of Rice in the United States. — Gustafson.

This article deals with problems involved in the production of rice in the United States such as design of canals, flumes, and pumping plants. It also gives some interesting facts about rice culture in general and discusses the 'duty' of rice as obtained in the United States. Rice in the United States is not grown in the marshes but on irrigated level land of a heavy texture with clay subsoil through which there is little loss by seepage. The United States grows about 0·5 per cent. of the total world production of this crop. The normal world production is 440 billion lbs. of rough rice yielding 273 billion lbs. of clean rice which is equivalent to 100 lbs. for every man, woman and child on earth. The climate suitable is mild with a mean temperature of 70°F. or above during the growing season. Water is first applied when the plants are 4 to 6 inches high. Irrigation is by a system of controlled inundation with contour levees. The area served by one cusec of water in rice irrigation as measured on 18 representative rice fields in the Sacramento valley was 47 acres and the average depth applied to the fields was 8·23 ft.

Air-mapping the Brazos River area. — Haquinius.

The proposed plan for the control of the Brazos River in Texas calls for a chain of 13 major dams on the main stream and its principal tributaries. The topographic maps of the reservoir areas were prepared from aerial photographs by the stereoscopic plotting method, and a new machine was used for the work. The field work involved in preparing the base sheets, or skeleton sheets, is described. Photogrammetrists build up the map on these base sheets with the plotting machines. A description of the machine and its manipulation is given, and some advantages of preparing maps by the aerial photography method are discussed.

MEASUREMENT OF IRRIGATION WATER. **Kidder.**

This article describes various types of metres available for the measurement of water in canals and closed conduits and emphasizes the importance of extending their use.

OUR READERS SAY.
PRESSURE DISTRIBUTION AND ACCELERATION AT THE FREE OVERFALL.

In this note to the editor Mr. Hunter Rouse comments on the article on Discharge Over a Free Fall published in the May 1937 issue of this journal. (See page 81 of Bulletin No. 6). He says that certain assumptions upon which the writer of the original article has based his developments are contrary to fact, and therefore the significance of his derivation of a new formula is open to question.

No. 8—August 1937.

THE PROGRESS OF IRRIGATION IN NORTH CHINA. Todd.

During the past decade, a number of irrigation projects have been developed in North China to conserve more thoroughly the available flow in the principal streams. In this movement, engineers who have studied western irrigation technique have endeavoured to introduce more modern methods of construction. Four of the larger and more important projects are discussed in this article. All the projects discussed consist of diversion dams across the rivers and systems of canals taking off from the rivers. The main features of the diversion dams are described. In two cases the diversion dams are constructed in rocky gorges of the rivers and the water is led into tunnels through the rock whence it emerges and flows in open channels, which form the irrigating system.

SETTLEMENT STRESSES FOUND WITH A MODEL. Bull.

Stresses in a statically indeterminate structure can be easily determined by the use of a wire model. Some recent improvements in the methods used are described. The solution of a practical settlement problem in connection with a multiple frame structure by wire model analysis is described in detail. In conclusion the writer emphasizes the value of models in investigation of behaviour of structures and points out the advantages.

TECHNIQUE OF SOIL TESTING. Buchanan.

At the U. S. Waterways Experiment Station at Vicksburg a special section has been devoted to the study of soil mechanics since 1931. At present it is busy with studies for many projects involving the use of earth as an engineering material. The present article describes the technique employed in performing the more important routine tests and gives examples of their use in the design of levees and earthen dams. The steps in the solution of a levee or an earth dam problem are sampling, testing, and the application of the data obtained to the solution of the problem. Soil sampling equipment and procedure are described. Soil testing consists of mechanical analysis, shear tests, determination of rate and amount of settlement, and permeability tests. The last one is very important because it relates to seepage through a levee or dam. The permeability tests are carried out on scale models constructed in glass sided flumes. The application of the data supplied by some of the tests is illustrated by explaining part of the general design of a levee.

COLORADO RIVER WATER FOR CALIFORNIA. Hinds.

The cities of Southern California have few local sources of water, and a scheme for supplying this area with water of the Colorado river stored in Lake Mead behind Boulder Dam is in course of construction. The scheme consists of a dam called the Parker Dam 155 miles downstream of the Boulder Dam on the Colorado river. Water will be released from the Boulder Dam into the river channel and will be diverted at Parker Dam into a line of waterways known as the Colorado River aqueduct which will convey the water to Southern California some 300 miles away. The main Colorado River aqueduct consists of a series of concrete lined tunnels, concrete pipe lines, buried concrete flow-line conduits, and concrete lined open canals with a total length of 242 miles. The system is designed to carry a discharge of 1,500 cubic ft. per sec. on the average.

The area to be served being very much higher than the water level at Parker Dam, the water will be pumped at five pumping stations along the line with lifts varying from 144 ft. to 441 ft.

Many details of this great work are given and new methods developed in construction are briefly described. The present stage of progress of the work is reviewed.

ENGINEERS' NOTEBOOK.

O'Shaughnessy

DISCHARGE OF NEEDLE VALVES AND SLUICEWAYS AT MADDEN DAM.

Methods and results of testing the outlet structures at Madden Dam (located on the Chagres River, in the Isthmus of

Panama) are described in this article. The regulation works at the dam include two outlet pipes equipped with needle valves, and six rectangular sluiceways controlled by gates. Tests were made to determine the actual head-discharge relationship for both of these appurtenances. The relationship curves obtained are given for both works.

COMPRESSED AIR MAGAZINE.

VOL. 42.

No. 1—January 1937.

WATER TO MAKE THE DESERT BLOOM. — **Coyle.**

The All American Canal Project is described in this article. This is a part of the Boulder Canyon Project and includes a diversion dam on the Colorado River 250 miles below the Boulder Dam, an eighty mile main canal to Imperial Valley. The climatic and geological characteristics of the region to be supplied with irrigation water are discussed and figures of area to be irrigated and cost of the project are given. Some of the mechanical equipment used in excavation work is described. The All American Canal will be 160 ft. wide at the bottom and 232 ft. wide at water surface. The depth of water will be 21 ft. and the capacity of the canal will be 15,155 cubic feet per second. Construction features of the canal are described. A fill section 8,200 ft. long, 144 ft. wide at bottom, 27 ft. wide at top and 26 ft. high was specially constructed to prevent seepage. A line of sheet piling was driven under the fill line 30 ft. deep and special material was used for the fill which was compacted by mechanical rollers.

Features of the Imperial Dam which will divert water into the All American Canal are described. (See page 88 of Bulletin No. 5).

CONTRACTORS AND ENGINEERS MONTHLY.

VOL. 33.

No. 5—November 1936.

HOG WIRE STOPS STREAM EROSION.

A method of preventing erosion of banks of streams by velocity checks made of wire mesh fencing fixed to rails driven in the bed of the stream has been used with success in Arizona. Details of this form of check is given and the placing of these in the correct position is explained.

DRAINAGE SWAMP LAND WITH VERTICAL DRAINS.

A portion of the approach highway to the San Francisco Bay Bridge lies over a swamp and is not stable enough for the highway embankment load. The California Division of Highways has formulated a theory that the swamp can be drained as the fill is being placed if suitable channels for the water are created before the fill is spread. These channels consist of vertical wells cut in the swamp and filled with gravel. The tops of these wells are connected to a system of drains filled with crushed stone and leading to the outside of the fill. The idea is that as the fill is being placed the water in the swamp will be pressed out by the weight of the fill through the vertical wells and the lateral system of drains out of the fill. This method is yet in the experimental stage. Details of the vertical and lateral drains and their construction are described.

VOL. 34.

No. 7—July 1937.

FURTHER DISCUSSION OF SCALING OF CONCRETE.

Some causes of scaling of concrete roads are described and effective treatments are indicated.

SYPHON AND BRIDGE CONSTRUCTION FOR ALL AMERICAN CANAL.

Coyle.

Some features of a few important structures for drainage, railroad and highway crossings on the All-American Canal are described. These include syphons, bridges, and overbridges. Important details as regards construction materials and plant are described.

ASPHALT AS STABILIZING AGENT FOR SANDY SOILS.

A procedure of stabilizing sandy roads by asphaltic material is described in this article.

SALT-STABILIZED TOWNSHIP ROAD.

A method of road surfacing is described which consists of spreading a layer of gravel on the subgrade and rolling it. Over the rolled gravel surface a layer of rocksalt containing 98 per cent sodium chloride was spread at the rate of 2 lbs. per square yard and the surface was again rolled. The road after treatment set up very hard and dense. Limestone dust was spread over the compacted surface to fill the surface pores while the surface was still moist.

ENGINEERING NEWS-RECORD.

VOL. 118.

No. 22—June 3, 1937.

(Annual Waterworks Number).

SELECTING PUMPING EQUIPMENT. Burdick.

Contains a general discussion of principles of selection of pumps for all purposes with particular reference to pumps for municipal water supplies. The gradual evolution of modern equipment from the crank and flywheel steam engine type of half a century ago to the modern electric centrifugal unit is traced.

GROUNDWATER SURVEYS IN CINCINNATI AREA.

Water levels in wells in this area have been declining gradually for many years. The water level has gone down 75 ft. since 1906. Information obtained during the recent investigations indicates that the possible causes of decline of water level include :--low rainfall in recent years; a change in the regimen of the Miami River following the construction of the flood control reservoirs of the Miami Conservancy district which may have reduced the possibility of groundwater recharge during periods of floods; the recent construction of a large intercepting sewer which has hastened the run off of both surface and groundwater; and the heavy and progressively increasing pumpage from wells.

CURRENT NEWS.

Completion of the two mile long spillway channel of the Fort Peck Reservoir will be a major construction operation this season. In the one mile long lined section, slots are cut in the shale of the sloping sides of the channel to act as keyways for the wall concrete. The shale was covered with cement mortar to check disintegration pending the placement of concrete.

No. 23—June 10, 1937.

THE WEEK'S EVENTS.

$800,000,000 FLOOD CONTROL PLAN.

A flood control plan for the Ohio and Mississippi Rivers and their tributaries which will cost $800,000,000 has been proposed by General Marham, Chief of Engineers. The scheme provides for the construction of numerous dams, creating detention reservoirs on the tributaries, miles of levees and river walls, channel improvements in the rivers to provide greater waterway, and establishment of floodways on the Mississippi. General Marham appeared before the House Flood Control Committee and said it is a mistake to suppose that his organization opposes reservoir construction. In protecting the alluvial valley of the Mississippi, the problem was to obtain the utmost protection with the money to be spent, and this has meant levees and channel improvements. With more money available, the Corps of Engineers favours storage reservoirs for flood control, although the net result as measured by reduction in flood crests is usually disappointing to reservoir advocates. General Marham's report states that the 1937 flood in the Ohio was unprecedented. Had the fourteen reservoirs already authorized been in operation, they would have reduced the flood heights by 5·5 ft. at Pittsburgh, 1 to 2 ft. at Cincinnati and less than half a foot at Cairo. Additional protection besides reservoirs is therefore necessary.

COMMENT AND DISCUSSION.

CAUSES OF LAND SUBSIDENCE.

Refers to an article relating to the subsidence of land surface in the Santa Clara Valley in California published in the April 1, issue of the Engineering News-Record. The writer says that there is little doubt that frequently the subsidence of areas of great extent is caused by the drainage from them of liquids like water and oil. Rocks and other strata with voids permeated by water or oil are in effect like a solid body submerged in a liquid the weight of which in the immersed state is less than its actual weight due to buoyancy. When the liquid is extracted, the weight increases and there is subsidence. The increase in weight may be from 60 to 65 per cent. This point is brought to the notice of engineers and others interested in large oil fields where settlements are occurring.

RECLAIMING A RIVERFRONT.

Describes the essential features of a scheme of park development along a 7 mile front of the Hudson River in New York, which includes a retaining wall of ingeneous design.

PUTTING SKID RESISTANCE INTO ROADS.

Some practicable processes for producing skid resistant surfaces are outlined in this article. Concrete surfaces may be made skid resistant by brooming the surface or by finishing it with a canvas belt. Both these operations bring the sharp sand grains to the surface. Application of corundum, carborundum, emery recrush and similar abrasives to the surface of the green concrete is very effective on concrete stairways and offers a possibility in building skid resistant concrete roads. The modern de-aired, vertical fibre paving brick with lugs provides an excellent wear resisting gritty surface finish. Sand, gravel and cinders can provide a uniformly high resistance to skidding providing the surface is firm and reasonably free from loose material.

WELLPOINTS ON SMALL BRIDGE WORK. Grover.

The use of well points for foundation work is usually limited to special and difficult problems but recently well points have been used with success in a few ordinary jobs in Kansas which include a few bridges across the Republican River in northern Kansas and a railway grade separation structure. Details of the well point installations used on these jobs are given. The installations were found particularly advantageous in fine sand that would leak through the joints of steel or timber sheeting.

FOUNDATION JOB INCLUDES MOVING A RIVER.

A steel sheet mill is being built in Cleveland on an eighty acre site in the bottom lands of the Cuyahoga River valley. The river actually flowed through the middle of this area in a horse shoe bend, the site occupying both banks of the river. A cut-off for the river channel eliminating the horse shoe bend was first constructed. This work required the digging of a new channel 1300 ft. long, 23 ft. deep and 200 ft. wide at the top with side slopes of 1 :1. The river was diverted to this new channel and the whole site including the old channel was raised 5 ft. above the existing level with 75,000 cubic yards of fill. The mill buildings occupy 21 acres and 17,000 concrete piles were placed for the foundations. The piles consisting of steel shells with concrete cores, were driven 60 ft. to shale and are designed for a load of 35 tons each. A sheet pile wall was also erected along the mill side of the new cut-off channel.

NEW AIDS TO THE CONSTRUCTOR.

A hollow burned clay roofing type has been placed on the market. It is fireproof and has high insulting value. Purlin spacings up to 8 ft. may be used for the roof frame. The weight is 13 lb. per s. ft.

No. 24—June 17, 1937.

COMMENT AND DISCUSSION.

FLOOD CONTROL.

Mr. Salberg of Chittagong, Eastern Bengal, criticizes the policy of flood control by levees in the alluvial rivers of America. The writer says that all alluvial rivers carry silt which must be deposited somewhere. If the river is controlled by levees, the silt can no longer be deposited in the river's flood plain but is carried to the mouth to built up the delta and also to lengthen the river. To get its discharge the river must raise its bed and consequently the flood levels are also raised. The levees in time have also got to be raised to prevent over-topping. This process has its limit when it would no longer be possible to raise the levees higher or to increase the river's grade by straightening. Some scheme therefore must be evolved to build up the plains with river silt first to replace the natural building up of the plain which has been upheld during the past eighty years of levee protection, and after that to keep pace with the river's natural growth.

The only solution in the writers opinion is a system of controlled spillways designed to flood and build up sectional areas, each with its discharge channel back into the parent river. Under this scheme large areas will have to be taken up by the State for the period of their re-conditioning. The obsession of protecting the many interests that have grown up in the flood plains under levee protection must disappear from the minds of the American Engineers if permanent control of floods is to be achieved.

A NEW TYPE OF CREST GATE.

Streiff.

The writer refers to an article on a new type of crest gate for the Emsworth Dam published in May 6, 1937 issue of the Engineering News-Record (See page 95 of Bulletin No. 6). He says that the design is not new at all and describes a lift-Tainter gate designed by him 20 years ago for an irrigation project in Siam. He considers however that for low dams in rivers with very high flood stages, the stoney, Roller and Tainter gates, dams are neither adaptable nor economical as the gates have to be lifted up high above the water level and require enormous piers, operating bridges and hoists etc. The piers in addition to their enormous cost, considerably restrict the channel area. For rivers with very high flood stages, preference should be given to moveable dams requiring low separating piers, with modern forms of beartrap which are low in cost, quickly operated and adaptable for automatic operation.

SELF-ANCHORED EYEBAR CABLE BRIDGE.

McCullough.
Archibald.

Describes a suspension bridge under construction in Guatemala. A special feature of the work is the use of eyebars for cables instead of wire strands. The bridge is of the self anchored type with a central span of 240 ft., and two 100 ft. flanking backstay spans. The horizontal tension component is taken by the bottom chord of the truss which carries the roadway. The truss is continuous, the bottom chord being rigidly fastened to the towers, one of which rests on a roller nest to allow free movement. The piers and abutments rest on a foundation of steel H beam piling. Details of the design are given.

FIRMING FINE SOIL WITH TAR.

Fahnestock.

This article describes some experimental road stabilization work undertaken in North Carolina with a view to ascertain whether a base which had proved inadequate could be stabilized and waterproofed by the use of bituminous material so that it would render satisfactory service. Two methods were employed. In the first method the existing road was scarified for a depth of 4 inches and the soil moved to the sides. Coal tar was then applied to the surface and was mixed with the soil material by a disc harrow. The material was then shaped and compacted by rolling. The compacted base was allowed to stand 36 hours after which the wearing surface which consisted of the same grade of tar as used for the base with half inch granite chips, was put on and rolled. A second method was to construct a 'sandwich' section which consisted of one inch of stabilized base soil covered by 5″ thick untreated soil over which was another layer of 1 inch of stabilized soil. This top layer was covered over by the wearing surface as in the previous method.

FLAT SLABS ON 25-FT. SPANS IN EARTHQUAKE RESISTANT SCHOOL.

Hammill.

Describes some features of design of a recent school building in San Francisco. The building is a two storey reinforced concrete structure so designed that the walls, roofs, floors, and interior columns act as rigid frame units to resist earthquake stresses. Brief details of roof and floor slabs are given.

FROM FIELD AND OFFICE.

CLEANING CONCRETE SURFACES TO ENSURE BOND

McFarland.

Large blocks of concrete built in successive lifts at Grand Coulee Dam required such large areas of surface to be cleaned for adding fresh concrete that many cleaning devices were tried. Some of them which proved successful are described. These are :

(1) Water-air jets. As soon as the concrete has set enough to stand it, the surface is cut with a jet of air and water. This takes off all the particles that are not firmly established in the concrete. The equipment consists of a Y shaped nozzle with connections for an air hose and a water hose. It is mounted on rubber tyred wheels and is moved along the surface of the concrete.

(2) Jetting with Power brush. This involves the use of a power driven brush for cleaning the surface. A circular brush with steel wire bristles is put on an electric driven floor sander. The brush is also fitted with a water connection so that the surface will be washed free of the cuttings.

A BETTER CROWN FORMULA FOR ROADS.

Cnare.

In Wisconsin, the transverse section of concrete pavements is shaped in accordance with the formula $Y = \frac{x^2}{100}$ where Y is the crown at any point and X the distance from centre line of the road to the point in question. This formula prodrces a curve which is rather flat at the top or crown of the road. The writer suggests a revised form of this formula which gives a slightly greater slope near the crown and less slope at the ends.

No. 25—June 24, 1937.

NEWS OF THE WEEK.

SMALL EARTHFILL DAM FAILS.

A small earthen dam in Colorado, 910 ft. long and 36 ft. high failed recently due to saturation of the fill. The dam was constructed in 1898 and a spillway for it was also excavated but was allowed to fall into disuse. In recent years a number of slips occurred due to saturation of the fill and drainage systems were installed as a corrective measure. A very recent slip extended to the crown and exposed a vertical face 9 ft. high, and the slip began to move. A cut 4 ft. wide was made in the structure near the spillway to lower the water level but this widened rapidly and all the water was discharged in a few hours, flooding the town of Austin, washing away a hundred yards of a railroad, and causing widespread damage to crops.

COMMENT AND DISCUSSION.

SOIL LOSS IN POTOMAC FLOOD.

Love.

Information is presented herein on silt loads and corresponding denudation over a drainage basin related to one flood in the Potomac river. The April 1937 flood in this river had a computed crest discharge of 348,000 c. ft. per sec. The maximum rate of silt movement has been computed as 78,300 tons per hour, and the total load of suspended matter during the five days of the flood was computed to be about 2,210,000 tons. This quantity represents material spread evenly over the entire basin to a depth of ·002 in. The maximum silt concentration was estimated to be 2·000 parts per million.

RECORD RIGID-FRAME BRIDGE.

Dunford.

Describes a cellular concrete bridge of 175 ft. span built in a park across a narrow ravine. The bridge is of the rigid frame type consisting of four large hollow concrete rigid frames set side by side. They are 8 ft. in width and of a depth averaging 5½ ft. at the crown and 18½ ft. at the haunches, where with a large circular sweep the horizontal girders connect with the legs, giving the appearance of an arch. The legs are of cellular construction, each terminating in a solid botton 5 ft. by 6 ft. in section. The base is shaped in the form of segment of a cylinder to form rocker bearings. The base fits into a similarly shaped socket on the top of the footing. The design is briefly outlined and the procedure of construction is described.

FAST SUBAQUEOUS TUNNEL DRIVING.

A brief account of the tunnel scheme below the Hudson River in New York was given in the previous issue of the Engineering News-Record. This article describes the tunnel driving operations in some detail. The driving shield and the various mechanical contrivances appurtenant thereto are described. The shield is a circular structure 31 ft. 8 in. in diameter with a circular cutting edge. The face of the shield is fitted with a bulk head having two openings 2′ 4″ square controlled by hydraulic gates. The muck collected by the cutting edge is driven through these openings as the shield advances and is removed by men working on a moving platform, into a conveyor moving on belts.

NEW AIDS TO THE CONSTRUCTOR.

A metallic lead pigment which is mixed with a suitable vehicle for application as a paint with brush or spray has recently been developed. The new product is said to be resistant to alkali, acid, fumes, and extreme temperature changes. It is recommended for buildings, bridges, water towers and steel structures generally, and as a seal coat on concrete.

VOL. 119.

No. 1—July 1, 1937.

CONTRACTORS WIN RIVER BATTLE.

Serious leaks occurred through the base of the Cofferdam which keeps the Columbia River out of the area in which the east section of the Grand Coulee dam is being built. A report on repair operations was published in an earlier issue of the journal (see page 93 of Bulletin No. 6). In this article additional information relative to conditions encountered and remedial measures adopted are given. It was discovered that cavities 1 to 3 ft. deep existed in the horizontal sand seam below the Cofferdam, through which water was flowing. Grout was pumped into these and observations were made to determine the best combination of ingredients for the grout. The following mixture was found to be the most suitable.

Sawdust	8	cu. ft.
Shavings from refinishing machines	10	cu. ft.
Portland cement	2	cu. ft.
Sand	6	cu. ft.
Lump bentonite	50	lbs.
Water	8	to 10 cu. ft.

To seal off small leaks, some 10,000 sacks of cement, largely with a 5 p.c. by weight of bentonite admixture, were placed inside the periphery of the Cofferdam cells.

WORKABILITY OF CONCRETES AND MORTARS.

Scripture.

Workability is one of the most important properties of concrete or mortar and without it, the potential value of other properties cannot be realized. The two factors which determine workability of concrete and mortar are mobility and cohesiveness. The requirements in concrete and mortar with respect to mobility and cohesiveness for different classes of work are discussed. Each concrete or mortar mix should be fitted to the special purpose for which it is to be used by varying these properties in such a way that workability is not impaired. Workability varies with proportions of components in a mix, particularly with the proportion of water. The problem therefore is resolved largely into one of securing maximum workability with minimum water. The effect of different proportions of the various components of a mix on mobility and cohesiveness are discussed. A marked improvement in workability can be secured by careful design to give just the right proportions and size grading of each ingredient. It is also possible to effect substantial improvement in workability by the addition of certain auxiliary agents to the usual components of concrete. These agents include finely divided puzzolanic material, lime, clay, some fatty acid salt such as soap, electrolytes, colloids such as glue and tannin etc., and organic dispersing agents. Their effects on workability are discussed generally and a table is given showing the effect of the addition of such materials on mobility, cohesiveness, and strength of a mix.

CHECKING TORRENTIAL FLOODS.

Describes the progress of Los Angeles County Flood Control plan on which work was begun in 1914. The area involved is 2,800 square miles, and flood control works include detention dams, debris basins, channel improvements including straightening and lining of natural stream beds, and spreading grounds for getting the flood waters into underground basins. Fourteen storage dams have been built and another is nearing completion

CONTROLLED QUALITY IN ASPHALT PAVING.

Shattuck.

Gives the history of the development of asphalt paving in the city of Detroit 85 p.c. of whose roads are of asphalt. A description is given of the present equipment of asphalt plant at Detroit and the paving methods employed are detailed. There is a laboratory to test rapidly all materials used in the manufacture of butuminous paving mixtures.

STEEL BAFFLES STOP SLIDING FILL.

Allen.

A road in the state of Indiana is cut in a hillside, half of the road resting on a bench cut in the hill and the other half on earth fill. The fill portion gave frequent trouble due to sliding. An ingenious method was adopted to arrest this sliding. The arrangement consists of a number of anchor bars fixed to reinforced concrete anchorages at the extreme end of the road on the hill side. The bars run across the full width of the road and down the slope of the fill and hold in position a number of steel retainer plates spaced at 12 ft. centres along the slope of the fill. These plates are buried in the fill. Steel plate cones are provided for the anchor bars where they bend over the edge of the road bank and follow the slope. The construction methods are described in brief. The plates are covered with earth and are not visible on the slope. The slope was completed 3 years ago and still shows no signs of moving to any extent.

DESERT WATER TANKS. Sykes.

Storage basins composed of gravel and sand confined behind small dams have been in use for more than a century to conserve water in the semi-arid regions of the south west. The dryness of the climate makes it difficult to conserve water in any type of open pond or reservoir. To meet these extreme conditions, water is stored in what are known as sand tanks. The sand tank is formed by a masonry dam built where the stream bed is confined within a rock-bound channel. The dam is well bonded into bed rock and the rock walls of the channel, the object being to intercept all water moving down as drainage. The streams carry a large amount of material which is deposited behind the dam, and it is in the voids of this deposited material, which consists of coarse gravel and sand, that water is stored. The percentage of voids is from 25 to 30 per cent. Evaporation losses are very much reduced and the water is kept free from contamination.

No. 2—July 8, 1937.

THE WEEK'S EVENTS.

The 40th annual convention of the American Society for testing materials was held in New York during the previous week. The technical report of the meeting covers subjects such as developments in steel, corrosion resistance, bituminous materials, paint, cement, concrete, masonry materials and timber.

COMMENT AND DISCUSSION.

CLOUDBURST FLOOD FORMULAS.

This is a letter from Mr. C. C. Inglis, India, to the Editor, Engineering News-Record on the Cloudburst' Flood Formula evolved by Gutmann. (See page 52 of Bulletin No. 4 and page 155 of Bulletin No. 6).

Bridge Building Follows Flood. Bowman.

The floods of March 1936 swept out hundreds of bridges and damaged many more throughout New England. So many bridges were washed out because flood stages were higher than ever before and because more ice was present than in any previous high water. The majority of bridge losses were connected with the failure of old dams on the small streams. The lessons in better bridge building emphasized by these failures are being applied to the replacement bridges. Larger spans, higher vertical clearances, deeper foundations, more positive anchorage of superstructure to substructure are some of the features of the new bridges.

Fast Tunnelling Clinches Sale of Water.

Marl Tunnelling Methods.

Gibson.

A tunnel has just been completed to provide additional water supply for Charleston. 1,000 men worked night and day and completed a 7 ft. tunnel through rock 18½ miles long in seven months. These two articles describe the progress of the work and give details of tunnelling methods adopted.

Municipal Sewage Irrigation. Mitchell.

Following the abandonment of an overloaded sand filter sewage treatment plant in 1928, Vineland, U. S. A. a town of 8,000 people adopted sewage irrigation farming as a means of disposal. The soil is coarse sand well adapted for drainage but not suited to farming unless irrigated and fertilized. In this article are described the layout of the farm, the details of the distribution system, preparation of the land for farming, cropping system, and irrigation practice at the farm. Some experiments on crop production and use of fertilizers which were carried out at the farm are mentioned. The cost data of the farm installation are given and the operating costs. Experience has shown that sewage irrigation if properly conducted is not a menace to health, and is practical and economical.

Structures to Control Torrents. Cruse.

This is in continuation of the article in the previous issue dealing with the flood control works of Los Angeles County, California. The County asked for Federal aid for flood control which was granted two years ago and was restricted to ten specific items of work. These ten projects are described in brief, and consist of two main classes of structures: (1) debris basins and dams at the mouths of mountain canyons with outlet channels leading to the main river channels (2) enlarged and improved channels for the Los Angeles River and its principal flood producing tributaries.

Some of the principal features of channel improvement works are described in greater detail. Many new bridges had to be built on the rivers where the improved channels ran through cities. Features of the construction work are also briefly outlined.

NEW EXPANSION JOINT PROVES GOOD. Webb.

Trial of a new expansion joint for concrete pavements has given excellent results in New York. The new device is called the flexible dowel, and consists of bent dowels used with premolded filler with form plates which hold the dowels in position in the filler. Each dowel consists of two deformed steel bars and two form plates. The bars are bent to place one end in the upper portion of one slab and the other end in the lower portion of the adjacent slab. The vertical portion lies in a slot in the expansion joint filler. A pair of these bars is placed in alternate positions in the two slabs. The installation procedure is described.

FROM FIELD AND OFFICE.

DESIGN FOR STADIA ROD. Dinsmoor.

A new design for a levelling rod is suggested herein.

CUT AND FILL VOLUME TOLD BY CHART. Arnold.
Warner.

A simple chart is given from which volumes of earth which must be moved in making cuts or fills of trapezoidal section over level ground can be computed. An example is worked out showing the use of the chart.

NEW AIDS TO THE CONSTRUCTOR.

HIGHWAY EXPANSION STRIP.

Effective sealing against moisture and temperature changes, and reduced noise are advantages claimed for this new expansion strip for joints in concrete highways.

PILE PULLER.

A cable grip for use in pulling piles from 14 to 18 inches in diameter has been recently placed on the market.

No. 3—July 15, 1937.

ASPHALT PLANT WITH PRECISION CONTROL. Proctor.
Shattuck.

Describes a new hot-mix asphalt plant recently installed in Detroit. Some of its special features are exact plant control of proportioning, mixing, and temperatures, and highly perfected uniformity of the mix. It is capable of turning out 80 tons of sheet asphalt mixture per hour. The process of storage and handling of the materials, preparation of the aggregate and other details about the functioning of the plant are given in detail.

New Record in Pouring Concrete.

This article contains an account of the progress of concreting the foundations for the Grand Coulee Dam and outlines experiences of the contractors in preparing the east half of the river bottom for concrete. About half of the concrete in the foundation contract has been laid, and future placing of concrete is scheduled at 440,000 cu. yd.. per month. Prior to excavation of the dam site some 200 holes were core drilled to an average depth of 225 ft. to test the nature of the overburden and the quality of the rock beneath. After the removal of the overburden, the operation of cleaning up of the bedrock which involved mostly handwork with pick and bar, was undertaken. The area of the concrete granite contract totalled 2,000,000 sq. ft. Mechanical placing of the concrete is described in brief. A new pumping plant for concrete cooling, consisting of horizontal grids of cooling pipes connected to headers which lead to supply mains through which river water is circulated, has been installed.

A. S. T. M. Convention at New York.

A brief review of the 40th annual convention of the American Society of Testing Materials held in New Pork from June 28 to July 2, 1937. The significant papers and specification developments that were presented are summarized by materials. Steel, cement, and concrete were the materials of major interest. Subjects discussed include yield point of structural steel, impact tests, corrosion of metals, fatigue of metals, cast iron tests, paints, bituminous materials, cement and concrete, masonry materials, brick efflorescence, and timber. One of the papers presented in the concrete session was on plastic flow of concrete. In the field of concrete aggregates, two new specifications were proposed and adopted. One of these is of light weight aggregate for concrete and the second covers a tentative method of test for abrasion of course aggregate by the use of the Los Angleles abrasion machine.

Rustproofing Fort Peck Penstock.

The four outlet tunnels for Fort Peck Dam are steel lined. In one of the tunnels, the steel lining is protected by a coating of coal tar enamel for a distance of 3,118 ft. downstream from the control gate shaft. The plant and procedure employed in applying the protective coating are briefly described.

No. 4—July 22, 1937.

River aqueduct distribution system 35 miles east of Los
Ground surface subsidence along a 2 mile length of the Colorado

Ground Subsides on 2-Mile Line.

Angeles has been observed during the past 3¼ years. In this period the ground surface has subsided by about 1 ft. The subsidence was detected as the result of periodical check of bench marks along the aqueduct line. The city engineer of La Verne which is situated in the area of subsidence is of opinion that the subsidence is the result of groundwater lowering, following which the alluvial soil material has compacted and settled during the drying out process. Water levels in this locality have dropped 100 ft. in 10 years.

MISSOURI RIVER BLOCKED AT FORT PECK. Chorpening.

The Missouri River at Fort Peck Dam has been diverted through four concrete lined tunnels for the completion of the Fort Peck Dam. The dam which is in course of construction is an earthen dam nearly 4 miles long of which the main section of 9,000 ft. lies in the valley proper of the river. The main section has a base width of 3,000 ft. and a maximum height of 242 ft. The dam was being built in two sections, one on each side of the river leaving a gap in the middle for the stream. On the completion of the tunnels the stream has now been diverted through them and the gap is being closed. The gap was 800 ft. wide and a railway bridge was constructed across it mainly for the transport of materials to the spillway. It was planned to close the opening by dumping material from the railway bridge on the upstream side but two days before the date fixed for the closure operations a slide of the fill on one bank of the gap occurred, endangering the safety of one pier of the railway bridge. The slide was on the downstream side of the bridge. Plans of closure operations were therefore changed and closure was started immediately by dumping rock and gravel from the railway bridge around the threatened pier and along the toe of the slide. Fleets of bull-dozers pushed the gravel into the stream from either bank of the gap and a derrick boat was engaged in building up a rock sill to hold the gravel in place against the current of the stream. The operations are described in details.

No. 5—July 29, 1937.

THE WEEK'S EVENTS.

BEDROCK REACHED AT PARKER DAM.

Bedrock was reached at Parker Dam site in what is stated to be the deepest excavation for the foundation of a dam, 230 ft. below the river bed. The Parker Dam will be of concrete arch type and will regulate the flow of Colorado River below Boulder Dam. It is 155 miles below Boulder Dam on the Colorado River.

SAN GABRIEL DAM COMPLETED.

San Gabriel Dam of the Los Angeles Flood Control District is a rockfill structure 355 ft. high, 1,670 ft. long at crest and 2,000 ft. thick at the base. It is the highest dam of this type ever built. The upstream and downstream slopes were originally proposed as 1½ to 1 but owing to the unsatisfactory nature of the available rock material, the slopes were finally altered to 3 :1. The cross section of the dam was divided into zones comprising a core of mechanically compacted quarried material, a clay-sand zone upstream of the core and a zone of quarried material on the extreme upstream side. On the downstream side, quarried material was placed grading from fine to porous on the extreme downstream side.

COMMENT AND DISCUSSION.

CROWN FORMULA FOR ROADS.

The writer has given another formula which he has been using for the past twenty years which gives the shape of the crown of the road, and is different from the formula given in the original article published in June 17, 1937 number of the Engineering News-Record.

BOULDER DAM EARTHQUAKES CONTINUE.

Earthquakes at Boulder Dam continued through the first half of 1937. No damage is reported but the frequency of shocks now occurring where none were reported before the completion of the dam has given rise to much speculation as to whether the cause lies in the extra load on the earth's crust imposed by Lake Mead. The U. S. Coast and Geodetic Survey have installed three instruments in or near Boulder Dam to record the earthquakes and two more instruments are to be installed one on either side of Lake Mead.

PLASTIC FLOW IN CONCRETE.

Davis.
Davis.
Brown.

"The purpose of this paper is to present the results of some of the investigations made at the University of California, all having to do with volume changes of concrete, and to point out the possible significance to design and construction problems of volume changes under the action of sustained load referred to as plastic flow".

The investigations were started in 1926 and comprise to date some 25 series of tests. The earlier series include studies to determine the effect upon plastic flow under sustained compressive stress, of (1) duration of loading (2) moisture and temperature conditions of storage (3) moisture content of concrete (4) gradation and character of aggregate (5) size of mass (6) age at time of loading and (7) reinforcement.

The more recent studies were for the determination of effect of water cement ratio and aggregate cement ratio upon plastic flow, the effect of fineness and composition of cement upon plastic flow, plastic flow in tension and compression, strains in plain concrete beams under constant sustained bending moments, and stresses developed in large concrete cylinders during a heating and cooling cycle, similar to that which will occur in mass concrete. The results of some of the studies are discussed. One important result refers to observations of plastic flow of ordinary portland and low heat Portland cements. It was found that concrete with low heat cement exhibited the largest plastic flow. Differences in degree of cracking of mass concrete structures is considered to be due to differences in plastic flow characteristics of the concretes forming the structures. In the construction of Morris Dam a modern low heat cement was used with the result that the structure is generally free from cracks. Another result indicates the existence of high stresses due to heating and cooling in mass structures. In the case of dams these stresses combined with the load may produce a stress system entirely different from that calculated by the usual methods which ignore the effect of thermal changes. Structural cracks in dams where contraction joints were provided point to the correctness of the above argument.

THIN-CORE HIGH EARTH DAM.

Strange.

The Ralston Creek Dam is being built about 20 miles to the north of Denver, U. S. A. The reservoir created will serve as a storage and distribution reservoir for the city of Denver. The dam is 1,150 ft. long at crest, 200 ft. high and has a base width of 945 ft. It consists of a central core section of selected clay, sand and gravel, moistened and thoroughly compacted by sheepsfoot rollers. The upstream section adjoining the core section is compacted sand and gravel and the downstream section is sand gravel and cobble with a heavy rockfill at the toe. There are 4 cut-off trenches 20 ft. wide excavated 8 ft. into the shale foundations under the impervious core section. These trenches are carried across the base of the dam up both abutments.

The Central core is built up in 6 inch layers, and the material from the pit contains 16 per cent. moisture. Construction of the tunnel and spillway is briefly described.

FLOOD "SAND BOILS" ANALYSED AT CAIRO.

Sand boils near levees frequently occur during high floods. The Superintendent of the Cairo Water Company in a paper read before the American Waterworks Association states that these boils are ordinary springs which flow only during periods when the normal sub-soil flow to and with the rivers is restricted. Contrary to popular belief this spring water does not come from the river.

Permanent treatment of sand boils does not present difficulties. The treatment consists of filling underground cavities with cement grout, forcing it down with compressed air, and spreading a blanket of clay over the affected area to raise the surface elevation to a point above which the ground water will not rise.

THE WEEK'S EVENTS.

A proposal has been made to make a five mile cut-off across a 22 mile river bed immediately below New Orleans on the Mississippi. The cut off would reduce flood stages at New Orleans and provide a shorter sailing distance for steamships using the port of New Orleans.

No. 6—August 5, 1937.

BRICK SCHOOL BUILT EARTHQUAKE-RESISTANT. Fork.

Reinforced brickwork construction has been adapted to meet the new and more stringent laws on earthquake resistance in a school building at Los Angeles. The structure has walls of reinforced brick masonry with floors and roofs of reinforced concrete. California's laws on earthquake resistant buildings require that in addition to all requirements for gravity loads, the structure must be able to resist 10 per cent. of these loads applied to the building laterally in any direction. Some special features of the brickwork construction are the use of specially shaped brick or brick units to provide channels for grout around the reinforcement and the development of a technique for filling the interior joints with grout. The different types of specially shaped bricks used are described, and the arrangement and use of these units are explained. The method of placing the cement grout between the joints is described. Mortar proportions used are given. The internal and external walls with roof and floor slabs form a rigid frame capable of resisting horizontal forces from any direction.

THE WEEK'S EVENTS.

EXTRA WATER DEMAND FOR AIR CONDITIONING.

The increasing use of air conditioning apparatus in the United States with a resulting demand for increasingly large quantities of water is a matter of growing concern. Installations of air conditioning apparatus have increased 1,400 per cent. from 1933 to the end of 1936.

SPILLWAY CHANGES MADE AT HORSE MESA DAM.

Major changes are being made in the spillway of the Horse Mesa Dam on the Salt River in Arizona as a result of 10 years experience. Flow from six gates totalling 67,000 sec. ft. at full opening was discharged directly down the canyon wall to the river 210 ft. below. A lip has now been added to the spillway so that the overflow is thrown clear of the canyon wall.

No. 7—August 12, 1937.

COMMENT AND DISCUSSION.

BEAM DEFLECTION.

Mr. Fleming in a letter says that the problem of finding deflexion of a beam is a very difficult one, and calls attention to two recent text books in which the subject has been discussed. Prof. Boyd, the author of several well known text books thinks that three methods are all that are worth while. These are :—the classical successive integration method, between limits; area moments method which is geometrical; and the elastic energy method which is dynamical. Mr. Drucker in another letter gives a method due to Prof. Witmer which he considers the simplest and most automatic to use. He discusses an actual example of a continuous beam to illustrate the use of the method.

TWIN TIED ARCHES FOR BALTIMORE BRIDGE. Schroedl.

A 55 year old pin connected truss bridge in Baltimore has recently been replaced by a modern steel tied arch structure on the old foundations. Considerations leading to the choice of this particular type of structure are discussed. The principal features of the design of the arches with the rigid top laterals connecting the two arch ribs at either end of the roadway are given. The roadway deck is made of welded interlocking steel channels, plug welded to the tops of the track and roadway stringers. The roadway is 40 ft. wide, accommodating two electric railway tracks.

FLOOD CONTROL BY RESERVOIRS. Morgan.

The floods of January-February 1937 have again brought into prominance the question of flood control in the Ohio Valley and the lower Mississippi. The actual flood heights and the flood discharges measured show that the system of protection under the Jadwin Plan is inadequate. The levees were tested to the practical limits of their capacity even though the flow did not reach the maximum allowed for under the plan. Levees alone are therefore not enough. On account of foundation difficulties, seepage, wave wash and kindred problems, it does not appear feasible to increase the height of the levee system throughout its length sufficiently to provide protection against maximum floods. Levees will continue to be necessary and play a dominant part for maximum protection but they cannot be relied upon to do the job alone, and must have help. The most promising help available is reservoir control. Effective reservoir control for the Mississippi Valley should include reservoirs located on the Ohio itself and its principal tributaries as far down on each stream as possible. The futility of controlling maximum floods in the valleys by head water reservoirs is evident to anyone who studies the 1937 floods and the distribution of the rainfall which caused it. The rainfall was intense in the lower and middle reaches of the Ohio River and its tributaries, and was light on the headwaters.

Two reservoir projects have recently been investigated by the Tennessee Valley Authority comprising reservoirs on the Ohio and the Tennessee Rivers. These are described and the points in favour of each of these projects are discussed. Of the two projects, one involving the construction of a dam on the Ohio River and another on the Tennessee River is considered to be the better. Flood control benefits of this project will extend throughout the greater part of the lower Mississippi valley. Other incidental benefits of the project to navigation, power development, reduced costs of levee maintenance, etc., are discussed.

Other reservoirs which have been completed, are under construction, or are being planned on the Ohio River and its tributaries, and which will have beneficial effect on the flood problem are mentioned. The importance of proper operation of a reservoir system for the control of floods is emphasized. The greatest benefit would be expected from a few large projects rather than from many small ones.

RETAINING WALL DESIGN. **Menuez.**

Two formulae are derived from which the base width of gravity retaining walls can be found if the values of top width and the height are given.

No. 8—August 19, 1937.

DESERT MENACE IN THE SAN JOAQUIN.

The Central Valley of California consists of the basins of the Sacramento and San Joaquin rivers which meet in the middle of the State and flow to the San Francisco Bay. Rainfall is heavy in this tract, but it receives little or no rain during a large part of the growing season. In the Sacramento valley, irrigation from the rivers is practised and is adequate for the requirements. In the San Joaquin Valley river water was scarce and ground-water was used for irrigation. But the agricultural development in San Joaquin valley went on without reference to the available water resources so that more area was developed than that for which a reasonable supply of water was available. A few dry seasons resulted in lowering of ground water level by a very large amount with the result that 50,000 acres of highly developed land were threatened with desert conditions. To save this land from the desert menace the Central Valley Project has been conceived. The scheme consists of a reservoir on the Sacramento River which will store previously wasted flood water. This water will be released into the Sacramento River whence it will be lifted into the San Joaquin valley *via* a canalized portion of the river and a supplementary canal system by a series of pumping plants. The water will thus be taken uphill to a tract 300 miles away. Power will be produced at the dam as a by-product.

BEACH EROSION STUDIES TO BE MADE IN WAVE TANK.

Describes a new 27,000 gal. wave tank being built by the Beach Erosion Board for the study of wave action on beaches.

EVANSVILLE TRANSFORMS ITS RIVERFRONT. Geupel.

An unsightly and neglected waterfront of a city on the Ohio River has been reclaimed. The various features of the works are a riverfront boulevard, a concrete wharf, a new levee and promenade extending over a mile along the river bank protected by riprap and a recessed basin for pleasure boats. Details of the various works are described and the effect of the 1937 floods on them are discussed.

FORESASTING MOUNTAIN WATER SUPPLY BY PHOTOGRAPHING SNOWFALL. Gross.

An original method of forecasting run-off from accumulated snowfall is being developed at Denver. Pictures of snow distribution are taken at regular intervals and correlated with run-off data from the watershed. The method is briefly described.

NEW YORK'S NEW BUILDING CODE. Strehan.

The history of the development of the new Code is outlined, the new code is compared with the old one, and the new regulations are critically analyzed.

NEWS OF THE WEEK.

Sub-Committees of the National Research Council have been set up to study density currents in Lake Mead and the Elephant Butte reservoir, and a programme of field observations on the flow of silty waters through these reservoirs is being formulated.

No. 9—August 26, 1937.

THE WEEK'S EVENTS.

As a result of not carrying the reinforcing steel in the deck slab of the George Westinghouse concrete arch bridge at Pittsburgh near enough to the face of the expansion joints, cracks have developed in the slab. Repairs will consist of placing structural steel shelf angles under the ends of the slabs at the expansion joints.

CALIFORNIA'S LONG-RANGE WATER PLAN.

Describes features of the Central Valley Project. The Kennett Dam on the upper Sacramento River will store water which will be pumped up to the San Joaquin River Valley. The major engineering features of the project are—

(1) Kennett Dam forming a large storage reservoir on the upper Sacramento river from which a regulated flow will be maintained down the river channel.

(2) Contra Costa Canal, a channel with pumping plants to carry water from the delta into the upper San Francisco Bay area.

(3) A series of pumping plants along the San Joaquin River to transport Sacramento River water upstream from the delta to the upper parts of the San Joaquin Valley.

(4) Friant Dam which will form a supplemental reservoir on the upper San Joaquin River for the supply of canal systems leading therefrom to the south San Joaquin Valley.

Details of the two dams and the canal systems are given. The Kennett dam will be a concrete gravity structure over 400 ft. high and the Friant dam is also to be a concrete gravity structure about 250 ft. high, and 3,380 ft. long.

In the Southern San Joaquin Valley an underground storage of 20,000,000 acre ft. within feasible pumping range is available for extraction. Utilization of this storage capacity in conjunction with surface storage is considered essential to meet the water requirements of the present irrigated area.

FINDING WEAK SPOTS IN BRIDGES. Berhard.

As an advance on static and moving load tests, European engineers have developed a method whereby induced vibration is applied to bridges as a means of locating defects, specially of welded structures. The equipment used and the procedure are described.

FIVE CLASSES OF FILL IN LARGE DAM. Jacobs.

Describes details of construction operations of a rock and earth fill dam being built on the Warrior River, 35 miles from Birmingham, Ala., U. S. A. The dam is 1,100 ft. long and 195 ft. high and consists of 5 classes of fill excluding rip-rap on the upstream face. These are clay, crushed rock 3″ diameter and under, 3″ to 15″ diameter quarry rock, and ½ inch diameter crushed rock screenings. Details of the crushing and screening plant used are given, and the construction of outlet and diversion tunnels and the spillway are described.

THE HIGHWAY MAGAZINE.

April 1937.

ROADBED STABILIZATION BY DRAINAGE. Cotton.

The importance of removal of free water by drainage from the vicinity of roads is emphasized, and free water conditions actually met with in practice are discussed with suggestions for dealing with them.

THE MINES MAGAZINE.

VOL. 27.

No. 2—February 1937.

MAPPING THE BRAZOS RIVER OF TEXAS. Fenton.

The Brazos River conservation and Reclamation District is an organisation established in 1934 with the object of controlling the floods of the Brazos River in Texas, U. S. A. The objectives of this organization are mainly flood control and reclamation of flooded lands. The scheme comprises thirteen dams on the main river and its important tributaries, with a number of small dams on the headwaters of smaller tributary streams. The surveys and mapping of these reservoir areas were carried out by aerial methods and these methods are described in detail in this article. The aerial survey methods of mapping consist of taking aerial photographs from an aeroplane and stereoscopic plotting. The plotting machine and its working are described and the various stages in the preparation of a complete map are set forth.

PROCEEDINGS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

VOL. 63.

No. 6—June 1937.

EFFECT OF DOWEL-BAR MISALIGNMENT ACROSS CONCRETE PAVEMENT JOINTS.

Smith.
Benham.

The subject of joints in concrete pavements to provide for expansion and contraction and the means of transferring loads across joints is important in highway construction. Dowel bars passing through the joint and embedded in the two adjacent slabs are generally used. It is necessary to install the dowel bars correctly perpendicular to the cross section of the pavement failing which they will not slip freely in the concrete. This paper describes an investigation to determine the accuracy with which the dowel bars were being installed in a particular work and another investigation which was conducted to determine by experiment the degree of precision necessary to assure satisfactory functioning of the joints.

ESSENTIAL CONSIDERATIONS IN THE STABILIZATION OF SOIL.

Hogentogler.
Willis.

The underlying principles involved in soil stabilization are discussed in this paper and possible means of soil stabilization are investigated. Design requirements of stable soil mixtures are laid down. Stabilizing action of various types of admixtures is described and details are given of exeprimental work with various admixtures and the results. The admixtures include Portland Cement, bituminous materials, waste sulphite liquor, molasses residues, calcium humates, and calcium silicate. A method is described of utilizing electricity for stabilizing soils. Tests used in soil stabilization are outlined. In conclusion, the author reviews the development of soil stabilization up to the present time and gives his conclusions in the light of the present knowledge.

SOIL REACTIONS IN RELATION TO FOUNDATIONS ON PILES.

Miller.

This paper is an attempt to correlate the collected data on pile foundations under varying soil conditions so as to discover reasons for success and failure. Records collated from 250 pile driving projects well distributed over the United States form the basis of this paper. The paper deals with bearing values of pile foundations in different soils, the behaviour of pervious and impervious soils, skin friction, load carrying capacity and static load tests, and spacing of piles. Some actual cases of pile foundation settlements are described and the causes of settlement are discussed. In conclusion, the author makes some recommendations which should be carried out to ensure satisfactory results.

DISCUSSIONS ON THE FOLLOWING PAPERS APPEAR IN THE ABOVE ISSUE OF THE PROCEEDINGS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

SIMPLIFIED METHOD OF DETERMINING TRUE BEARINGS OF A LINE.
ECONOMIC DIAMETER OF STEEL PENSTOCKS.

STRESSES AROUND CIRCULAR HOLES IN DAMS AND BUTTRESSES.

GRAPHICAL DISTRIBUTION OF VERTICAL PRESSURE BENEATH FOUNDATIONS.

RAINFALL INTENSITIES AND FREQUENCIES.
FLOW CHARACTERISTICS IN ELBOW DRAFT-TUBES.

ECONOMICS OF HIGHWAY-BRIDGE FLOORINGS OF VARIOUS UNIT WEIGHTS.

NATIONAL ASPECTS OF FLOOD CONTROL : A SYMPOSIUM.

THE PASSAGE OF TURBID WATER THROUGH LAKE MEAD.

THE RECLAMATION ERA.

VOL. 27.

No. 6—June 1937.

THIRTY-FIVE YEARS OF DAM CONSTRUCTION. Swanton.

The Reclamation Act was passed in 1902 and since then the programme of the Bureau of Reclamation has thus far involved the construction of 160 storage and diversion dams in addition to which 19 dams are in progress at the present time. Brief accounts are given of the some of the more important dams such as the Elephant Butte Dam, the Boulder Dam, and the Grand Coulee Dam, and some important features of these dams are mentioned. A list is given of the dams exceeding 50 ft. in height built by the Bureau of Reclamation.

INTERESTING CONSTRUCTION AT HORSE MESA DAM. Larsen.

The Horse Mesa Dam on the Salt River in Arizona was completed in 1927 but soon after completion a number of undesirable conditions became apparent with the operation of the dam and power plant. The most important of these was the discovery that the spillways though designed for a discharge of 150,000 cusecs, discharged only 90,000 cusecs. When discharging, the water from the spillways flowed down the short aprons, and striking the rocks near the bottom of the Canyon was deflected in such a manner as to drench the substation on the top of the power house. It was therefore decided to build an auxiliary spillway tunnel around the north abutment of the dam. Laboratory tests on models indicated that the discharge capacity of the spillways could be increased by constructing new ogee aprons on the downstream side of the crests. This would also remove the objectionable conditions near the power house, and the water from the spillway would leap clear of the Canyon wall and drop directly on the river bed.

Some of the difficult and trying features of the job are described which includes, besides the tunnel and the spillway mentioned above, filling of a large cave near one of the abutments, a spiral stairway on the vertical downstream face of the dam, and a suspension footbridge.

The Horse Mesa Dam is a plain concrete structure of the variable radius arch type 305 ft. high and 784 ft. long with a base width of 57 ft.

No. 7—July 1937.

CONSTRUCTION OF RYE PATCH DAM. Foster.

The Humboldt project of which the Rye Patch Dam is the principal feature is located in Western Central Nevada on the Humboldt River. The Rye Patch Dam is of the straight earth fill type having a maximum height of 80 ft. and a length of 800 ft. The base thickness is 505 ft. The upstream face has a slope of 5 to 1 and the downstream face a slope of 2 to 1. Both upstream and downstream faces are covered with a gravel blanket. The dam is keyed into the foundation by 4 cut-off trenches, one of which is the main cut-off trench and three are subsidiary trenches. The main cut-off trench is located 80 ft. upstream of the axis of the dam. A wall of steel sheet interlocking piling is driven through the sand stratum across the river bottom into the clay stratum below in the main cut-off trench. The earthfill of the embankment was rolled by mechanical rollers.

The spillway is of the overflow type and is of reinforced concrete. The outlet works consist of a circular tunnel 462 ft. long and 12 ft. in diameter.

THE NOXIOUS WEED CONTROL PROGRAM ON THE SHOSHONE PROJECT, WYOMING. Corkins.

Describes some weed control and eradication methods and mechanisms successfully used in Wyoming.

C. C. C. EROSION AND FLOOD CONTROL PROGRAM, RIO GRANDE PROJECT. Mealey.

Describes some works carried out by the Civilian Conservation Corps in the Rio Grande Valley for erosion and flood control. These include masonry dams, check dams, and contour terracing.

No. 8—August 1937.

THE PROGRAM AND OBJECTIVES OF THE RECLAMATION BUREAU. Stoutemyer.

Describes some of the objectives of the Bureau of Reclamation which include flood control, improvement of navigation, and power generation.

CONSTRUCTION OF PINE VIEW DAM, OGDEN RIVER PROJECT. Imrie.

A history of the project is given and the objects to be served by the project are mentioned.

The main feature of the project is the Pine View Dam constructed across the Ogden River in Utah. The dam is an earth and rock fill structure with a maximum height of 102 ft., and a length of 500 ft. A cross section of the dam showing the materials used in the various parts of the dam is given. A cut-off trench with sheet piling driven to bedrock is provided.

Details of diversion tunnel, spillway, and foundation conditions and operations are given.

EIGHT THOUSAND MILES OF RECLAMATION PROJECTS. Smith.

Describes a tour of inspection covering twenty reclamation projects and including 35 dams in all stages of construction. Some important features of a few projects are briefly mentioned.

SCIENCE.

VOL. 84.

No. 2167—July 10, 1936.

THE EFFECT OF IRRIGATION UPON SOIL TEXTURE.

The effect of irrigation upon soil texture has been noted in the Salt River Valley, Arizona. A soil survey of certain areas was made in 1899 and another in 1927. There are great differences in the results which clearly indicate a change in the characters of the soils. These changes are described and are attributed to irrigation, which has produced clay loams and clays out of sandy loams. The Salt River water used for irrigation has 300 to 500 parts per million of total salinity in floods, and 1,500 parts per million in low flow. The use of water of this high salinity has hastened the soil disintegration. Two results of this change are important. First, the increase in clay content has made penetration of irrigation water very slow which causes an accumulation of salinity in the soil. The second effect is the liberation of soluble matter within the soil which may have a damaging effect on it.

JOURNAL OF THE COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH.

VOL. 10.

No. 3—August 1937.

INFLUENCE OF RICE FIELDS ON LOCAL HUMIDITY AND TIME OF DEW DEPOSITION.

West.
Mallaby.

This paper presents results of investigations to determine the effect of rice fields on humidity and time of dew deposition in neighbouring areas. It has been found that rice fields cause slight decrease in temperature and increase in both relative and absolute humidity during day time, and increase in humidity and an earlier deposition of due at night. The influence is however in-appreciable beyond the distance of 2 chains from the rice field.

JOURNAL OF THE INSTITUTION OF ENGINEERS, AUSTRALIA.

VOL. 9.

No. 6—June 1937.

Nothing of interest to irrigation engineers in this issue.

No. 7—July 1937.

DISCUSSIONS AND COMMUNICATIONS.

THE INFLUENCE OF AREA-SHAPE ON RUN-OFF. Hawken.

The author of the original paper which was published in December 1935 issue of the journal replies to the various comments on his paper.

RIVER FLOOD MEASUREMENT FROM HEIGHT RECORDS. **Hawken.**

Comments by Mr. Kemp on the above paper published in the August 1936 issue of the journal, with the reply of the author of the original paper.

PUBLICATIONS OF VARIOUS GOVTS., INSTITUTIONS, SOCIETIES, ETC.

ENGLAND.

Ministry of Transport and Ministry of Agriculture and Fisheries.

JOINT COMMITTEE ON DAMAGE TO FISHERIES: DETAILED BIOLOGICAL AND CHEMICAL REPORTS ON TARS USED FOR ROAD-SURFACING.

The Committee was appointed in 1920 to investigate the question of the alleged pollution of streams by drainage from tarred roads. Results of investigations are presented in this report.

Institution of Civil Engineers.

MINUTES OF PROCEEDINGS, 1934-35, VOL. 240.

CONSTRUCTIONAL ENGINEERING WORK IN THE NEW DUNSTON POWER STATION FOR THE NORTH-EASTERN ELECTRIC SUPPLY COMPANY LTD. Anderson.

The site of the power station being poor as regards foundations, it was decided to adopt reinforced concrete pile foundations. The reinforced concrete piles were 14 inch square ranging in length from 25 feet to 50 ft. The concrete mix of the piles was one part of Portland cement, one part of clean coarse sharp sand from 3/16 inch gauge downwards and two parts of aggregate passing through a 1½ inch square mesh but retained by a 3/16 mesh. The piles were driven by drop hammer 70 cwt. in weight and of the single acting type. Details of reinforcement of the piles are given, and pile driving operations are described. Some important features of the construction of the turbine house, boiler houses and other appurtenant structures are given.

SPEED IN RELATION TO CURVATURE, WITH SPECIAL REFERENCE TO ROAD-CURVES. Royal-Dawson.

A study of the relationship of speed and curvature on a highway is presented in this paper. Transition curves are discussed and working formulas are given for the design of curves. Superelevation and the method of its application to transition curves are discussed and a method of calculating superelevation is given.

ASPECTS OF HIGH-WAY-CURVE DESIGN. Criswell.

An article on the design of road curves. An analysis of various forms of transition curves is given, vertical curves are discussed and a number of tables are attached which are of great help in the design of road curves.

THE ISKANDAR BRIDGE, PERAK, FEDERATED MALAY STATES. Coales. Clarkson

Describes the design and main features of construction of a bridge consisting of 7 spans of two hinged steel arches, the largest span being 160 ft. at the centre and decreasing to 150 ft., 130 ft., and 104 ft. respectively towards each end. The abutments and piers are founded on mass concrete caissons and the work in the foundations is described in detail.

THE NEW KHEDIVE ISMAIL BRIDGE, CAIRO, EGYPT. Stephen.

The new bridge was erected at the site of an old lattice girder bridge which was dismantled. The dismantling operations are described. The new bridge is a girder bridge with a reinforced concrete deck slab consisting of two shore spans of 43·1 metres, four fixed spans of 50·00 metres and two swing spans of 48 metres. The abutments and piers are founded on reinforced concrete caissons. Details of the caissons and steel work are given and the swing span with its operating mechanism is described at length. Construction operations are described in detail.

REMEDIAL MEASURES ON THE ARAPUNI HYDRO-ELECTRIC SCHEME OF POWER DEVELOPMENT ON THE WAIKATO RIVER, NEW ZEALAND. Furkert.

This paper deals with the remedial measures carried out in connection with the Arapuni Hydroelectric Power Development installation in New Zealand after the occurrence of a crack in the rock under the head race. The trouble at the works included seepage through the rock underlying the dam, erosion of rock at the spillway falls and a crack in the rock which occurred when the reservoir behind the dam was filled up. The remedial measures included concreting of the spillway falls, lining of the head race and grouting and dowelling in the vicinity of the dam. An account is given of the damages in the sequence of their occurrence and the carrying out of the remedial measures are described in detail.

THE PYKARA HYDRO-ELECTRIC DEVELOPMENT. Platts.

Describes the design and construction of the Pykara Hydro-Electric Scheme in the Madras Presidency. Rainfall and run-off are discussed in detail and it is shown how the storage capacities were arrived at. The works include the Glen Morgan Dam and two earthen bunds at the upper and lower end. The dam is of random rubble masonry and is 50 ft. high. Some details are given of the construction operations. The power house, its machinery and equipment are also described.

THE LAWS OF A MASS OF CLAY UNDER PRESSURE. Ravenor.

This paper presents the results of a study of the problem of a large mass of clay subjected to the pressure of a finite area. The author has conducted a large number of tests in the field, and has been able to reconcile his tests with the actual settlement of structures erected in the same clay. The laws that have been deduced from a rational interpretation of the tests confirm experiments made by other investigators. The author has enunciated a law of induration, that is, the behaviour of clay during its ductile stage. The author's investigations show that clay is not a homogeneous material as assumed by Rankine. He describes the apparatus used by him in his tests and discusses the results of his experiments. He has derived an equation relating load and settlement based on his experiments.

The Royal Society.

PROCEEDINGS OF THE ROYAL SOCIETY, SERIES A, MATHEMATICAL AND PHYSICAL SCIENCES, NO. 892, 2ND DECEMBER 1936, VOL. 157.

THE FORCES ON A CIRCULAR CYLINDER SUBMERGED IN A UNIFORM STREAM. Havelock.

A solution is given in this paper for the two dimensional wave motion due to a circular cylinder in a uniform stream, taking fully into account the condition at the surface of the cylinder.

FLUID FRICTION BETWEEN ROTATING CYLINDERS.
I. TORQUE MEASUREMENTS. Taylor.

Results of certain experiments carried out with the object of measuring the torque between concentric rotating cylinders with fluid in between are given in this paper.

II. DISTRIBUTION OF VELOCITY BETWEEN CONCENTRIC CYLINDERS WHEN OUTER ONE IS ROTATING AND INNER ONE IS AT REST. Taylor.

Describes certain experiments carried out to measure the distribution of velocity under the conditions stated and gives results obtained.

THE MOVEMENT OF DESERT SAND. Bagnold.

Experiments on the motion of sand grains and their reaction on the air stream when wind blew over a thick uniform layer of sand were carried out in a wind tunnel devised by the author. These experiments are described in this article. The paths of individual grains were photographed. Total mass flow of sand past various sections of the tunnel were measured directly. The wind velocity distribution in the tunnel was also measured.

HUNGARY.

ANNUAL REPORT OF THE HYDROGRAPHIC INSTITUTE OF THE ROYAL HUNGARIAN MINISTRY OF AGRICULTURE, 1935. [With an abridged report (in English) on the activities of the Hungarian Hydrographic Institute from 1886—1936]. (In Magyar.) Laszloffy.

SITUATION PLAN, PROFILES, AND CROSS SECTIONS OF THE TISZA RIVER. (In Magyar.)

These two publications record the work done on Hydrology in Hungary during the last fifty years. The volume of plans is extraordinarily fine and although references are in Magyar, notes in English enable the plans to be understood.

"The Tisza river is noticeable for three reasons : (1) On account of its exceptionally small slope 0·00001—0·00005, it has special peculiarities from the point of view of hydraulics and hydrology. (2) Much may be learned from the radical regulations carried out upon the river—the length of its lower reach has been reduced by 112 cut-offs from 700 to 435 miles, i.e., by 38 per cent. (3) The greatest flood-controlling work in Europe has been done within its basin —2,200 miles of levees, 6·4 million acres of protected areas".

The immense amount of work done during the last fifty years, as described in these publications, makes one wonder how much similar information is available regarding such rivers as the Ganges in India. The English summary states :—"The improvement of regulation and the prevention of flood catastrophies was rendered possible only by a systematic study of the nature of the river".

The following is extracted from the abridged report :—"Hydrometry in this country to a certain extent developed in a special way. As our rivers have small velocity and copious discharge, and carry very fine material, we were compelled to adjust instruments and methods of measuring to these conditions. In rivers of small velocity only easily-revolving current meters could be employed, and their bearings had to be constructed so that the fine silt in suspension should constantly be rinsed out of them. The current meter constructed by S. Hajos answered these demands ; it has been used in this country, and was introduced into Russia before the war, and recently also into Czechoslovakia and Yugoslavia. It was necessary to find out a quick method of survey for cross-sections, more than a thousand feet wide and 30—70 feet deep, without diminishing the accuracy of results. In 1897 Samuel Hajos employed the so-called differential method, which is simply an improved variation of the integrating method. The essence of the differential method is that the current meter is lowered with uniform speed from the water surface to the bottom and meanwhile every turn of the wheel is marked on a slip of paper in the function of the water depth and the time. From the data obtained in this way, the curve of velocities in a vertical line can be drawn and completed down to the bottom. The current meters are rated according to a method proposed by S. Hajos by drawing the instrument in still water with gradually increasing, then decreasing speed. By this method the process of rating can be accomplished in a short time".

ITALY.

ANNUAL REPORT ON HYDROLOGY 1933 : PART II—DATA. (In Italian.).

This publication records the hydrological studies in Italy for the year 1933. Details of all gauging stations and methods employed are given.

RUSSIA.

Academy of Sciences in the U. S. S. R., 1936, Vol. III (XII), No. 4(99).

THE INFLUENCE OF CAPILLARITY OF SOIL FILTRATION WITH FREE SURFACE. Vedernikov.

Describes the various forces governing the movement of water in the groundwater and capillary zones. The author concludes that the movement of water in the capillary zone and in the groundwater zone is a single indivisible movement obedient to various normal forces, and says that the movement of water in the capillary zone is distinguishable from that in the groundwater zone by means of the atmospheric pressure and by a diminution of the speed of filtration in ratio to the changes in humidity and pressure along the level or height of the zone.

SWEDEN.

Royal Swedish Institute for Engineering Research.

ON VELOCITY FORMULAS FOR OPEN CHANNELS AND PIPES. Lindquist.

The object of this publication is to bring together in a single compilation the different formulae used in various countries for velocities in pipes and open channels. In the first place the empirical formulas for open channels in use at the present day are discussed and the origin of the formulae is traced. These include the Chezy formula, Lameyer's, Humphrey Abbott's, Darcy-Bazin's, Ganguillet-Kutter's and Manning's formula. The author then discusses the empirical formulae used for pipes and outlines their development.

Summarizing his review of the various empirical and theoretical formulae on flow of water in pipes and open channels the author says that two theoretical formulae have been developed by Von Karman and Prandtl for computing the velocity in pipes with smooth and rough walls. These formulae being too complicated for practical use, a variation based on research data of the last twenty years is suggested. Concerning open channels such as canals, flumes, rivers, etc., in agreement with the experience of the last 40 years, the use of the Manning formula is suggested.

INDIA.

Central Government.

FINAL REPORT OF THE DELHI TOWN PLANNING COMMITTEE ON THE TOWN PLANNING OF THE NEW IMPERIAL CAPITAL, 1913.

Considerations leading to the selection of the present site, description of layout, recommendations regarding special points concerning water supply and drainage, etc., are given.

NEW CAPITAL AT DELHI: APPENDIX TO PRELIMINARY REPORT AND ESTIMATE: NOTES ON HYDRAULIC INFORMATION, 1913. Sopwith.

These notes have been prepared from the information collected during the investigations that ended in the selection of the site for the Imperial Capital and deal with the subsoil water and river conditions of the two proposed sites to the north and south of the old city of Delhi.

MODERN BARRACKS WITH PARTICULAR REFERENCE TO RAWALPINDI (WEST RIDGE).

Describes a modern type of barracks suitable for air conditioning. The necessity of air conditioning and the essentials of the design of an air conditioning plant are discussed. A statement showing the cost of the barracks is given, together with drawings of the barracks and a children's school attached to them.

ANNUAL REPORT OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH FOR 1936-37.

A report of the activities of the Imperial Council of Agricultural Research in various provinces of India. The progress of several Agricultural Research Schemes undertaken by the Council is described and a further programme is given. The agricultural research includes research in sugarcane, rice, wheat and breeding of rust resistant wheats, potato, and horticultural research. Some experiments are being carried out in Bengal to find the minimum water requirements of rice and the critical stages of the growth of rice. A soil research scheme is also in progress in Bengal.

COPY OF A PRESS NOTE ON "THE SARDA CANAL, (BENGAL)", 25-8-1937.

This note describes the benefits conferred by the Damodar Canal, and gives a brief history of the canal which was built during the years 1926—1932.

COPY OF A PRESS NOTE ON "THE SARDA CANAL, UNITED PROVINCES", 21-9-1937.

This note gives figures of area irrigated by the Sarda Canal in 1935-36 and the gross receipts and the net revenue during the same period. A brief history of the scheme is given from the early inception of the project in the middle of the ninteenth century to its final sanction in 1920. The difficulties encountered during the construction of the project are related. The main features of the main canal and its branches and of some important works on them are described and certain figures are quoted to indicate the magnitude of the undertaking. The benefits conferred by this project are related.

Forest Research Institute, Dehra Dun, Timber Development Section.

The pamphlets mentioned below have been issued by the Forest Research Institute of Dehra Dun to popularize the use of timber in building and other engineering construction. Recently in some advanced western countries, engineers are forming the opinion that wood is the most economical and practical material for many modern structural purposes. This is because of two reasons, firstly, because wood can now be made durable for a very long period and secondly, that new forms of timber joints and wood structures have been evolved. The pamphlets are as below :—

WOOD'S CHALLENGE TO STEEL AND CONCRETE. Pamphlet No. 1. Kamesam.

The advantages of wood as compared to steel and concrete as structural materials are described.

RELATIVE ECONOMY OF WOOD, STEEL, AND CONCRETE STRUCTURES. Pamphlet No. 2. Kamesam.

Compares costs of timber, steel and reinforced concrete structures.

MANUFACTURE OF SMALL DIMENSION STOCK A NEW RURAL INDUSTRY. Pamphlet No. 3. Kamesam.

"Small dimension stock" refers to wood pieces of different standard sizes. This stock has a ready market in towns and cities. The writer suggests the manufacture of small dimension stock by unskilled labour in rural areas as a measure of improving the earning capacity of the villager.

THE TRUTH ABOUT FIRE HAZARD IN TIMBER STRUCTURES. Pamphlet No. 4. Kamesam.

It is stated that fire hazard in a timber structure is not more than that in a steel or concrete structure.

CHEAPER AND BETTER GABLE ROOFING WITH WOOD SHINGLES. Pamphlet No. 5. Kamesam.

Types of roofing now in use in India are described and a cheaper and better type of timber roofing is suggested.

TREATED TIMBER FOR EARTHQUAKE RESISTANT STRUCTURES. Pamphlet No. 6. Kamesam.

Discusses the action on buildings during an earthquake, analyses relative damage to reinforced concrete, steel framed and wood framed houses, and enumerates some of the advantages of treated wood as an eminently suitable structural material for earthquake resistant construction.

TREATED WOOD POLES FOR ELECTRIC DISTRIBUTION AND SERVICE. Pamphlet No. 7. Kamesam.

BETTER AND CHEAPER FENCING. Pamphlet No. 10. Kamesam.

HOW TO BUILD WOODEN EARTHQUAKE AND STORM-PROOF HOUSES. Pamphlet No. 11. Kamesam.

Lays down sixteen principles of construction by following which even a layman can build a house for himself of wood-frame construction.

RELATIVE COST OF TREATED ELECTRIC POLES AND OVERHEAD CONSTRUCTION IN INDIA AND ABROAD. Pamphlet No. 13. Kamesam.

Shows the cheapness of treated timber electric poles as compared to steel poles.

TREATED TIMBER BRIDGES FOR INDIAN HIGHWAYS AND RAILWAYS. Pamphlet No. 15. Kamesam.

Discusses timber truss and trestle type bridges and their durability and suitability to Indian conditions both in railway and highway engineering.

WOOD *VERSUS* STEEL FOR FRAMED BUILDINGS. Pamphlet No. 18. Kamesam.

Compares initial cost, effect of weather, safety against fire, maintenance, acoustics and other features of steel frame and wood frame buildings.

HOW TO BUILD FIRE-RESISTANT TIMBER STRUCTURES. Pamphlet No. 19. Kamesam.

Some principles of fire resistant timber construction are detailed.

Survey of India Department.

PAMPHLET CONTAINING SPECIMENS AND PRICES OF VARIOUS MAPS AND INFORMATION ABOUT OTHER WORK UNDERTAKEN BY THE SURVEY OF INDIA DEPARTMENT.

Institution of Engineers (India).

IMPACT FOR R. C. BRIDGES. (Advance copy of paper) Korni.

The problem of impact has been investigated by various authorities in different countries over a large number of years but there is still no clear or definite formula of impact for bridges of different types. Recently the Bridge Standard Committee in India issued a formula for impact for all classes of road bridges. The author analyses free and forced vibration in bridges and gives formulas for their calculation and discusses the effect of spring on impact.

He derives an expression for impact on a railway girder bridge where the rolling load is directly moving on the girders. Impact on reinforced concrete bridges is then discussed and it is shown that deformation due to a moving load is much less in the case of reinforced concrete bridges than in the case of a steel bridge. The impact factor for R. C. bridges can therefore be safely assumed at a considerably less value than that for steel bridges. In conclusion, he suggests values of impacts to be adopted for different types of R. C. Bridges.

BENGAL.

Irrigation Department.

GOVERNMENT OF BENGAL ANNUAL IRRIGATION REVENUE REPORT FOR THE YEAR 1934-35.

THE BENGAL DEVELOPMENT ACT, 1935.

This is an Act to provide for the development of lands in Bengal and to impose a levy in respect of increased profits resulting from improvement works constructed by the Government.

THE BENGAL TANKS IMPROVEMENT BILL, 1937; WITH STATEMENT OF OBJECTS AND REASONS AND NOTES ON CLAUSES.

This bill has been enacted to provide for the improvement of tanks in Bengal for purposes of irrigation.

Agricultural Department.

SEASON AND CROP REPORT OF BENGAL AGRICULTURE DEPARTMENT FOR THE YEAR 1936-37.

UNITED PROVINCES.

Irrigation Department.

FINANCIAL HANDBOOK: PUBLIC WORKS ACCOUNT RULES, VOL. VI, FIRST EDITION, 1937.

BOOK OF FORMS REFERRED TO IN FINANCIAL HANDBOOK, VOLUME VI, 1937.

Agricultural Department.

REPORT ON THE ADMINISTRATION OF THE DEPARTMENT OF AGRICULTURE FOR THE YEAR ENDING 30TH JUNE, 1936.

CENTRAL PROVINCES.

Irrigation Department.

ADMINISTRATION REPORT OF THE IRRIGATION BRANCH FOR THE YEAR ENDING THE 31ST MARCH 1936.

Agricultural Department.

ANNUAL REPORTS OF EXPERIMENTAL FARMS IN THE CENTRAL PROVINCES FOR THE YEAR ENDING THE 31ST MARCH 1936.

REPORT ON DEMONSTRATION WORK CARRIED OUT IN THE WESTERN CIRCLE TOGETHER WITH REPORTS ON THE SEED AND DEMONSTRATION AND CATTLE-BREEDING FARMS OF THE CIRCLE FOR THE YEAR ENDING THE 31ST MARCH 1936.

PUNJAB.

Irrigation Department.

ADMINISTRATION REPORT WITH STATISTICAL STATEMENTS AND ACCOUNTS FOR 1934-35.

COMPLETION REPORT AND SCHEDULES, SIRHIND CANAL, 1893.

IRRIGATION BRANCH TECHNICAL NOTES, CLASS B, NO. 2—NOTE, DATED 10TH SEPTEMBER 1922 ON "MASONRY SETTINGS FOR KENNEDY'S GAUGE OUTLETS".

A type design for a masonry setting for gauge outlets is given and practical considerations leading to the design of this particular type of setting are discussed.

REPORT ON INFORMATION REGARDING IRRIGATION AND DRAINAGE, WITH SPECIAL REFERENCE TO WATER-LOGGING, COLLECTED DURING A JOURNEY FROM BOMBAY TO ENGLAND, VIA AUSTRALIA, NEW ZEALAND, PANAMA, HAVANA AND THE UNITED STATES OF AMERICA, BETWEEN 1ST MAY, 1935 AND 23RD AUGUST, 1935. **Montagu.**

The author (formerly Secretary of the Central Board of Irrigation) gives a brief account of the origin of the tour undertaken by him and gives a detailed description of the tour arranged in chronological order. He has described in detail the various works visited and the various problems discussed by him in the course of his tour with engineers and other persons in the countries visited.

The report is extremely interesting and contains information on a large variety of subjects, some of which are mentioned below :

Waterlogging problems in Victoria State and their solution.

Destruction of surplus energy on the standing wave principle at the Madden Dam in Panama and mud grouting of limestone fissures to prevent leakage.

The Mississippi River channel, and the Bonnet Carre spillway; articulated concrete slabs to check erosion at river bends; the U. S. waterways experiment station at Vicksburg and experiments with concrete models of the Mississippi River; block revetments for river bank protection; inspection of river channel.

The Bureau of Reclamation research laboratories at Denver, Colorado, and investigations being carried out there; laboratory for the testing of earth materials; hydraulic laboratory for model tests of spillways of various dams.

Inspection of the Rio Grande Project; discussion of the problem of waterlogging with Mr. Fiock, the leading authority on waterlogging in the service of the Bureau of Reclamation.

The cement and concrete testing laboratories at Denver, Colorado.

A discussion on the question of carrying out works by direct labour under the control of the officers of the Bureau instead of through contractors.

Irrigation Research Institute, Punjab.

RELATIVE EFFICIENCY OF A VERTICAL SHEET PILE UNDER A FLUSH FLOOR. Research Publication, Vol. II, No. 19, October 1936. Malhotra. McKenzie-Taylor.

"A new symmetrical expression is obtained for the pressure taken up by a pile placed anywhere under a flush floor. It is shown that pressure cut off by the pile is greatest when it is placed at the ends of the floor, and least when it is in the middle.

The lengths of piles placed at different points under the floor and cutting off the same fraction of total head are investigated.

The variation of the head cut-off by the pile with changes in its depth is studied".

SOME NOTES ON KHOSLA'S PRINCIPLE OF INDEPENDENT VARIABLES. I—MUTUAL INTERFERENCE OF EQUAL PILES AT ENDS OF A FLOOR. Research Publication, Vol. II, No. 20, October 1936. Malhotra. McKenzie-Taylor.

While investigating the design of weirs on permeable foundations, Rai Bahadur A. N. Khosla obtained an empirical formula for the correction to percentage pressure due to the mutual interference of piles. The authors were recently able to obtain a theoretical solution for the standard case of a floor provided with equal end piles. The same investigation was also carried out experimentally by electric methods. The percentage pressures as obtained by the theoretical method, as obtained by Mr. Khosla's empirical formula, and as determined by experiments are compared, and it is found that there is a remarkable agreement between theory and Mr. Khosla's values. It is shown that there is a theoretical basis for the formula within the range of floor-piles ratio met with in actual practice. The formula is further extended to include all values of the above ratio.

Buildings and Roads Branch.

PUNJAB P. W. D. SPECIFICATIONS, VOL. I, 1936 (Buildings and Roads).

A handbook of specifications for all materials commonly used and methods of construction in the Public Works Department, Punjab.

Legislative Department.

PUNJAB LEGISLATIVE ASSEMBLY DEBATES, VOL. I, Nos. 9 & 10, June 1937.

Certain questions were asked in the Punjab Legislative Assembly regarding :

1. Fall of water level in Jullunder and Hoshiarpur Districts,
2. The Bhakra Dam Scheme.
3. Water rates.

These questions and their answers are given, and also the general discussion on the budget.

BOMBAY.

Irrigation Department.

IRRIGATION ADMINISTRATION REPORT, BOMBAY PRESIDENCY, PART II—ADMINISTRATIVE ACCOUNTS AND STATISTICAL STATEMENTS FOR THE YEAR 1934-35.

COPY OF NOTE, DATED 7TH AUGUST 1913 OF THE CHIEF ENGINEER FOR IRRIGATION, BOMBAY, (MR. H. F. BEALE), REGARDING LOWER SITES FOR THE BARRAGE AT SUKKUR.

The question of selecting site below the gorge at Sukkur for the barrage was considered in 1905 and the reasons why such a site was considered unsuitable are given. Considerations for location of the site above the gorge are then discussed in detail. Attention is drawn to the possibility of the formation of shoals between the guide banks above the barrage and the general raising of the river bed for some miles upstream. In conclusion, the objections to the lower sites are summarized.

HISTORY OF CANAL HEADWORKS—EKRUK TANK, SHOLAPUR.

The Ekruk Tank comprises a reservoir formed by an earthen dam 7,000 feet long and 76 ft. maximum height. The area of waterspread is 6½ sq. miles. A history of the project is given and a number of plans containing details of the project are attached.

A CONCISE HISTORY OF THE GOKAK CANAL AND STORAGE WORKS IN THE BELGAUM DIVISION, UP TO THE YEAR 1936-37.

This project consist of a weir across the river Ghataprabha 6,836 ft. long with a maximum height of 27 ft. and comprising a masonry section 2,985 ft. long flanked by earthen bunds. A canal system takes off from behind this weir for the irrigation of the surrounding country. The works are described and a brief history of the inception of the project is given.

HISTORY OF THE MHASWAD TANK AND CANALS UP TO THE YEAR 1936-37.

The scheme is described and its history is traced back to its first inception in 1887. The scheme consists of a reservoir formed by an earthen dam 9,000 ft. long with a maximum height of 80 ft. across the river Rajewadi and a canal taking off from the reservoir. Details of the tank, the dam with its core of selected soil going down to impermeable rock, the waste weir, and the canals are given.

HISTORY OF THE MUTHA CANALS SYSTEM (KHADAKWASLA DAM) UP TO THE YEAR 1936-37.

This system comprises a masonry dam across the Mutha River at Khadakvasla about 11 miles from Poona, and a system of canals taking off from the river. The dam consists of a concrete core section covered with masonry on both faces. It is 4,827 ft. long and is 102·5 ft. high above the river bed. It goes down another 28 ft. below the river bed to rock and the base width at foundation level is 75 ft. The waste weir consists of 88 automatic gates, 12 rolling gates and 3 needle gates. Details of the canals are given.

HISTORY OF THE HEADWORKS OF GIRNA CANAL (CHANKAPUR DAM) UP TO THE YEAR 1936-37.

This briefly describes the works which consist of Chankapur storage tank and a pick up weir lower down with a system of canals. The storage tank is formed by the Chankapur Dam, a rubble and lime masonry structure on solid rock foundations 1,506 ft. long with a maximum height of 140 ft. The pick-up weir which is 23 miles below the storage tank is of stone and lime masonry and is 1,100 ft. long. Details of length of canals and areas commanded are given.

HISTORY OF THE HEADWORKS OF GODAVARI CANALS (DARNA DAM) UP TO THE YEAR 1936-37.

The principal details of the scheme are given. The works consist of a storage reservoir and a pick-up weir. The dam forming the storage reservoir is a gravity structure of uncoursed rubble masonry in lime, the top portion of the dam consisting of concrete hearting with masonry faces. It is 5,360 ft. long with a maximum height of 94 ft. Details of the pick-up weir and head regulator are given.

HISTORY OF THE PRAVARA CANALS HEADWORKS (WILSON DAM AND PICK-UP WEIR AT OJHAR).

This scheme comprises the Wilson Dam at Bhandardara and the Pravara canals. The Wilson dam is by far the highest dam in India being 270 ft. above river bed level. Water stored in the reservoir formed by this dam is released into the river and is later passed into the Pravara Canals by a pick-up weir 53 miles below. Details of length of the canal systems and areas commanded are given.

HISTORY OF THE NIRA CANALS HEADWORKS (LLOYD DAM AND PICK-UP WEIR AT VIR).

The storage reservoir for the Nira Canals is formed by the Lloyd Dam at Bhatgarh which is a masonry structure 5,330 ft. long, and 194 ft. high above foundation level. The lake formed by the dam has a catchment area of 128 sq. miles. Foundations of the dam are described. The pick-up weir for the canals is 17 miles below the reservoir, Brief history of the construction of the Nira canals is given and main features of the canals are described.

HISTORY OF THE HATHMATI AND KHARI CUT CANALS HEADWORKS.

These works are in the Bombay Presidency. Their history is traced and they are briefly described.

HISTORY OF THE VISAPUR TANK AND CANAL PROJECT UP TO THE YEAR 1936-37.

The Visapur Tank is formed by an earthen Dam, 7,440 ft. long and with a maximum height of 84 ft. The reservoir is designed to store 1,329 million cubic ft. The headworks consist of a masonry culvert 225 ft. long passing through the dam and controlled from a tower built on the inner side of the dam. The canal system is briefly described.

SIND.

Public Works Department (Irrigation).

IRRIGATION ADMINISTRATION REPORT FOR THE YEAR 1933-34. PART II.

REPORT ON EXPERIMENTS WITH A MODEL OF KHESANO REGULATOR ON THE ROHRI CANAL, MILE NO. 194. CARRIED OUT IN THE DEVELOPMENT AND RESEARCH DIVISION AT THE KARACHI TESTING STATION. Sind P. W. D. Technical Paper No. 1.

Bushby.
Hiranandani.

The Chief Engineer, Sind, noticed a very unusual intensity of turbulence below the regulator and a large eddy and back current in the expanding flume. It was also noticed that at times the current changed sides due to some unaccountable disturbance in the conditions of the flow, the current generally being deflected to the left. It was therefore considered necessary to construct a model of the regulator to find the necessary modifications which would produce an even flow.

The model was constructed 1/12 full size and details of its construction are described. A number of experiments were conducted with baffles in various positions to determine the final modification to be adopted. The principles of fluming as contained in Central Board of Irrigation Publication No. 6 were also tried but with no success. Brief descriptions of the experiments are given. The final plan adopted was a baffle which enabled the standing wave to be formed upstream of it and dissipated the surplus energy.

In conclusion it is stated that the experiments proved beyond doubt that conditions in the prototype could be reproduced in the model with a fair amount of accuracy.

A number of plates giving details of the various experiments carried out are included.

REPORT ON OBSERVATIONS ON THE JAMRAO CANAL SYSTEM TO STUDY CONDITIONS FOR NON-SILTING CHANNELS IN SIND, 1930—33.

In August 1929 the Chief Engineer in Sind was asked to carry out an investigation to study conditions for non-silting channels in Sind. The items of enquiry are :

(1) Do the dimensions of regime channels in Sind support Kennedy's formula in its fundamental form?

(2) If so, are the constants the same for Sind as for the Punjab?

(3) If not, what values are to be adopted?

(4) If the dimensions of regime channels in Sind do not support the Kennedy formula do they indicate any other formula connecting critical velocity with depth or connecting the discharge carrying a given silt charge with dimensions of the channel?

(5) Is the critical velocity in any way connected with the hydraulic mean depth?

The Jamrao canal system running for over 30 years was selected and 22 sites of varying discharges from 10 to 200 cusecs were fixed upon for observations.

This report gives the procedure adopted for taking observations and the result of observations. The results are discussed in great detail. In conclusion, replies to the items of enquiry mentioned above are given on the basis of the results obtained.

STATEMENT SHOWING FINAL AREAS OF RABI CULTIVATION AS COMPARED WITH FORECASTED FIGURES FOR THE YEAR 1936-37 FOR THE LLOYD BARRAGE CANALS.

"There is a decrease of cultivation to the extent of 17,545 acres. The decrease is due to slump in the price of wheat and more area coming under cotton crop, it being more paying."

WEEKLY STATEMENTS SHOWING KHARIF CULTIVATION AREAS UP TO 11TH SEPTEMBER 1937 IN SIND AS COMPARED WITH THOSE OBTAINED UP TO THE CORRESPONDING DATE LAST YEAR.

There is an increase of cultivation to the extent of 9,877 acres on the Right Bank canals and 141,233 acres on the Left Bank canals.

Agricultural Department.

Annual Report of the Department of Agriculture in Sind for the year 1935-36. Jenkins.

In Chapter II the' working of the Barrage Canals and effect on agriculture in the Barrage areas in 1935-36 are discussed. Chapter III deals with agricultural research and investigation which include investigations on cotton, wheat, rice, and soil and irrigation research. The water requirements of main crops grown in Sind have been studied in great detail at the Agricultural Research Station, Sakrand. Maintenance of soil fertility has also been a matter for study.

MADRAS.

Public Works Department.

Madras Public Works Department Administration Report for the year 1935-36. Part II—Irrigation.

Circular Memorandum No. 216-Wks./35—8, dated 22nd May 1936, regarding building foundations in black cotton soil.

Some general principles to be followed in the design of buildings to be founded on black cotton soil are laid down and the causes of cracks in buildings founded on that soil are discussed.

BALUCHISTAN.

Agricultural Department.

Annual Report of the Agricultural Department in Baluchistan for 1936-37.

The report contains detailed information about fruit research carried out in Baluchistan and a general account of the operations of the Department of Agriculture.

INDIAN STATES.

Mysore State (Public Works Department).

Marconahalli Reservoir Project, Mysore State.

This projected scheme comprises a reservoir formed by a masonry dam across the river Shimsha. The proposed dam consists of a masonry section 456 ft. long with two earthen flanks at either ends, 2,508 ft. and 2,310 ft. long respectively. Other details of the project such as catchment and yield, capacity of reservoir, run-off and discharges adopted, and works appurtenant to the dam are given, The canal system is also described in brief.

IRRIGATION IN MYSORE.

This is a note describing irrigation conditions in Mysore State. The irrigated area in the State is about one-sixth of the total cultivated area. The bulk of irrigation is done from tanks numbering about 25,000 and irrigating about 8 lacs acres out of a total irrigated area of 11¼ lacs acres. There are about 40,000 wells irrigating about one lac acres of area. Amongst river channels, the Cauvery river channels irrigate about 1·15 lacs acres and by the recent construction of the Krishnaraj Sagar Dam it has been possible to increase this area by another 1¼ lacs acres. Irrigation from Cauvery has almost reached its limits.

Mysore State (Department of Agriculture).

FACTORS AFFECTING SPRAY SUCCESS IN THE CONTROL OF COFFEE LEAF DISEASE. Mysore Coffee Experiment Station Bulletin No. 15. **Mayne.**

ANNUAL REPORT OF THE COFFEE SCIENTIFIC OFFICER, 1936-37. Mysore Coffee Experiment Station Bulletin No. 16. **Mayne.**

BRIEF INSTRUCTIONS FOR THE GUIDANCE OF LAY PERSONS REGARDING IMPROVEMENT OF ANIMAL INDUSTRY, CHIEFLY CATTLE, SHEEP AND POULTRY. Circular No. 56. **Monteiro.**

THE COFFEE STEM BORER AND ITS CONTROL. Circular No. 57.

SOME DO'S AND DON'TS IN REGARD TO POULTRY AND SHEEP BREEDING. Circular No. 58.

BURMA.

Irrigation Department.

ADMINISTRATION REPORT OF THE PUBLIC WORKS DEPARTMENT (IRRIGATION BRANCH). BURMA FOR THE YEAR 1935-36.

MALAYA.

Annual Report of the Drainage and Irrigation Department of the Federated Malay States and the Straits Settlements for the year 1936. Robinson.

This contains information on irrigation, drainage and river conservation operations in the Federated Malay States and the Straits Settlements. An important advance made is the replacement of temporary brushwood dams on rivers by permanent masonry dams with a special type of radial gate developed to meet the river flood conditions encountered. River training operations are described and some of the river training works are unique.

SUDAN.

Irrigation Department.

A report on a study of Indian Irrigation Works. Williams.

This report records the results of a tour undertaken by the author, of Irrigation works in India. The author visited Sind, the Punjab, the North-West Frontier Province, the United Provinces, and the Bombay Presidency. The report describes the organization of a typical Indian Irrigation Department and its administration. Canal works of various types including headworks, falls, regulators, etc., visited by the author are described and principles of design of spillway syphons, non-silting offtakes, flumed works, river training works, and ease and cut waters for piers have been outlined. One full chapter is devoted to research in Irrigation ir which investigations being carried out on irrigation problems in various provinces are mentioned and several of the conclusions of these investigations have been embodied. Some of the more important headworks and the problems that had to be tackled in their design and construction are described. Mr. Lacey's theory of stable channels in alluvium is discussed at length, and the problem of waterlogging is dealt with.

The book contains very useful information for engineers in India and the author has referred to problems in Egyptian canals to which the knowledge gained by him during his Indian tour could be advantageously applied.

AFRICA.

Annual report of the British East African meteorological service for the year 1936.

UNITED STATES OF AMERICA.

Department of Agriculture.

SNOW-SURFACE TEMPERATURE. **Horton.**
Reprint from Monthly Weather Review, Vol. 62, April 1934. **Leach.**

In studying evaporation losses for high altitudes it becomes important to determine the mean snow surface temperature. Observations of snow-surface temperatures were made by the authors using maximum and minimum thermometers. The results are presented herein.

BIBLIOGRAPHY ON LAND DRAINAGE.

A complete bibliography on the subject of drainage. The names of the publications are arranged under different subjects and countries, and an author index is given at the end.

Department of the Interior (Bureau of Reclamation).

SECOND ANNUAL REPORT (SIXTH PROGRESS REPORT—16TH, 17TH, 18TH AND 19TH SETS) ON RETROGRESSION OBSERVATIONS BELOW BOULDER DAM WITH NOTES ON OTHER SILT INVESTIGATIONS ON THE COLORADO RIVER AND THE ALAMO CANAL, MAY 27, 1937. (Confidential). Corfitzen.

The results of the 16th, 17th, 18th and 19th sets of observations on the retrogression of the Colorado River bed below Boulder Dam are presented in this publication, and a resume of results of all previous observations is given. Observations on the suspended load of the Colorado River at Imperial Dam site and at Red Cloud Cable Station 23 miles upstream and in the Alamo Canal are also presented.

Department of Public Works.

CENTRAL VALLEY PROJECT UNIT BIDS OPENED. KENNETT DAM SITE APPROVED BY U. S. Reprint from Official Journal of the Department of Public Works, March 1937. Kelly.

This pamphlet describes the progress of the project. The Kennett Dam is the key structure of the project, and the site for the dam has been approved. The U. S. Bureau of Reclamation is the constructing agency and they have started preparatory work. The Kennett dam will be constructed of concrete and will be about 420 ft. high. The reservoir so formed will serve several purposes. A portion of its capacity will be reserved during winter and early spring for control of floods. A cyclax core drilling machine used for exploration of site of the dam is illustrated. This drill removes a core of rock 3 ft. in diameter.

War Department (U. S. Waterways Experiment Station, Vicksburg).

THE IMPROVEMENT OF THE LOWER MISSISSIPPI RIVER FOR FLOOD CONTROL AND NAVIGATION.
In 3 volumes. Elliott.

This publication presents a comprehensive outline of the history of the improvement of the Lower Mississippi River for flood control and navigation from the time of the discovery of the Mississippi River to the present day.

It begins with the history of discovery of the river and the establishment/ of settlements along it The growth of settlements was followed by improvement in navigation. Levee building dates back to the time of the earliest settlements which were established in the beginning of the eighteenth century. The problem of flood control came into prominence after the floods of 1849-1850. The history of the formation of the first Mississippi River Commission is traced leading up to the reorganization of the Commission in 1928.

The physical characteristics of the Lower Mississippi River are then described. The river has an alluvial valley and the drainage basin has an area of 1,245,000 sq. miles which is 3 times as large as the area of the Ganges Basin. The river banks consist of alluvial deposits and are subject to more or less continuous erosion in the shape of caving and sinking. The occurrence of cut-offs and their effects on stages above and below are discussed in some detail. A short description of important recorded natural cut-offs on the Mississippi is given.

In discussing the hydraulics of the lower Mississippi it is observed that confinement of flood waters within levees has increased elevations of flood crests considerably. The method of calculation of discharge of the Mississippi River is given. The sediment investigations made on the lower Mississippi and the characteristics of the river in relation to the transportation of solid matter are discussed.

One whole chapter deals with the levee system of the Lower Mississippi. The development of the levee system from the earliest times to the present day is outlined. The useful life of a levee is considered to be 30 years. Levee construction methods and implements are described in detail.

Other items dealt with are improvement of navigation by dredging, bank protection methods, and contraction works for decreasing the low water channel width and increasing the depth with a view to improve navigation.

The last chapter contains a theoretical discussion of flood control methods with particular reference to the Mississippi River. The principles governing the preparation of a flood control plan are discussed at length. Flood control methods discussed are reforestation, channel relocation, which involves the diversion of the flow of tributary stearms to the sea by artificial channels, river channel enlargement, river channel shortening, reservoirs for flood storage, floodways or outlets, and levees. The development of the Lower Mississippi flood control works is traced from the earliest times and the various flood control plans prepared before the institution of the Mississippi River Commission in 1879 are discussed in detail. These plans were not executed at the time for various reasons. The flood control plans of the Commission are also described and the progress of flood control operations is traced up to the reorganization of the Commission in 1928. A reservoir Board was appointed to report on the suitability of reservoirs for flood control in 1927 before the phenomenal floods of that year. The Committee was of opinion that although reservoirs would reduce floods, the protection so afforded would not eliminate use of other flood control works. After the 1927 floods, a number of flood control plans were prepared, the chief amongst which were the plan of the Mississippi River Commission, and the Jadwin plan. These plans are discussed in detail. The Jadwin plan was ultimately adopted for execution. A brief description of floodways as proposed in the plan is given.

National Research Council (American Geophysical Union).

TRANSACTIONS OF THE SEVENTEENTH ANNUAL MEETING APRIL 30, MAY 1, 2, 1936 AND WEST COAST MEETING JANUARY 31 AND FEBRUARY 1, 1936. PART II—REPORTS AND PAPERS SECTION OF HYDROLOGY AND WESTERN INTERSTATE SNOW-SURVEY CONFERENCE.

Reports and papers under the hydrology section are contained in this publication. The following are some of the reports and papers under this section :—

Report of Committee on Absorption and Transpiration.

Report of Committee on Rainfall and run-off.

Report of Committee on Physics of soil moisture.

Report of Committee on Underground waters.

Report of Committee on Dynamics of streams.

Some problems relating to fluctuations of groundwater level.

Long time records of groundwater levels on Long Island.

Maximum groundwater levels.

Fluctuations in groundwater at Woodgate, New York.

Decline of Artesian head in South Dakota.

Recovery of groundwater levels in Nebraska.

Fluctuation of groundwater level in Utah.

The underground water index : its relation to surface run-off.

Seepage of water through porous media under the action of gravity.

Historical development of ideas regarding the origin of springs and groundwater.

Methods of studying fluctuations of groundwater levels.

Notes on the transportation of silt by streams.

The twin problem of erosion and flood control.

Experimental study of the scour of a sandy river bed by clear and muddy water.

Fluvial morphology in terms of slope, abrasion, and bed load

American Farm Bureau Federation.

SIXTH ANNUAL CONFERENCE OF INSTITUTE OF IRRIGATION AGRICULTURE, MARCH 30, 31 AND APRIL 1, 1937.

Some of the papers presented are as follows :—

Forecasting irrigation water supply by snow survey.

Irrigation practice as a factor in soil erosion.

A discussion and demonstration of the fundamentals of soil and water relations as applied to irrigation practice.

The Willamette Valley project from the viewpoint of the farmer.

Artificial recharging of underground water supplies.

Correlation of Range Land Use with Irrigation project needs.

Factors that determine the feasibility of a reclamation project.

American Association for the Advancement of Science.

THE SCIENTIFIC ASPECTS OF FLOOD CONTROL : Silcox.
A SYMPOSIUM. Supplement to "Science", Lowdermilk.
Cooke.

Vol. 84, No. 3, October 1936.

The symposium consists of the following :—

INTRODUCTION BY COOPER.

Explains the relation of the science of ecology with flood control. Ecology is the science of plants and animals.

FORESTS AND FLOOD CONTROL. Silcox.

Discusses the part played by forests in flood control. Adequate forest cover on the watersheds alleviates flood crests and reduces the frequency of floods. Forest conditions in the early days of settlement in America are compared with the present day conditions and it is stated that destruction of forest cover has resulted in quicker run-off, floods, erosion of top soil, and depletion of groundwater storage due to quicker run-off. Erosion conditions in the U. S. A. are described and the means of controlling floods and erosion are discussed. The soil conservation service in the U. S. A. is carrying on a programme of erosion and stream flow research and erosion control. Some examples of the effect of forest cover upon stream flow and flood crest are quoted and their beneficial effects are emphasized. The manner in which forest cover helps in soil conservation and reduction of run-off, and the chemistry of the process are described. The question of silting of reservoirs by silt formed by erosion is mentioned and a strong case is made out for "upstream engineering" in flood and erosion control.

AGRICULTURAL LAND USE AND FLOOD CONTROL. Lowdermilk.

Effect of a proper agricultural land use programme on average annual run-off and soil loss is discussed and it is shown that woodlands and grasslands on steep slopes absorb all but a few per cent. of the total annual rainfall. Hazards of cultivation of land are considered and principles of safe and sustained land use so as to obviate these hazards are discussed. Land use for the prevention and control of erosion is described and strip cropping, terracing, and similar measures are discussed. Erosion control measures are designed to meet one or more of the following objectives : (1) to increase the capacity of cultivated soils to absorb and infiltrate water so that there is no depletion of underground storage (2) to provide for retardation and control of surface flowage (3) to rehabilitate soils which are damaged or ruined by erosion. Each of the above objectives and the means of attaining it are discussed.

ON THE RELATIONS OF ENGINEERING SCIENCE TO FLOOD CONTROL. Cooke.

The author believes that flood control is a problem of up-stream as well as down-stream engineering. Prevention as well as counteraction are both necessary. The value of up-stream engineering in erosion control and flood control is emphasized.

University of Arizona, Agricultural Experiment Station.

GROUNDWATER LAW IN ARIZONA AND NEIGHBOURING STATES. Technical Bulletin No 65, December 29, 1936. Smith.

This Bulletin discusses the principles of groundwater law and the existing law in Arizona and neighbouring States.

Ohio State University Engineering Experiment Station.

LIST OF PUBLICATINS ISSUED BY THE STATION.

SOIL SURVEYS FOR HIGHWAYS. Circular No. 33, July 1936. Eno.

A brief history of soil survey methods with a review of present practices is contained in this publication.

Tennessee Valley Authority.

TENNESSEE VALLEY AUTHORITY, 1933—1937.

The Tennessee Valley Authority was constituted by the U. S. Government in 1933 with the object of controlling and utilizing the Tennessee River for the benefit of the surrounding country. The Authority is carrying out an integrated plan of development of the Tennessee River for navigation, flood control, agricultural development and national defence. This pamphlet outlines the problems which the Authority has faced, the manner in which it has dealt with them, the results so far attained, and the work which still remains to be done.

The navigation and flood control plan comprises the construction of a series of high dams on the Tennessee River. To make tests of conditions at dam sites, a soil mechanics laboratory was established at Norris in 1935 where soils for embankments and foundations are tested. All dams are tested by model experiments at the authority's Hydraulic Laboratory at Norris.

Power production and the future market for power are discussed. Soil conservation is an important item of the unified plan and comprises a forestry programme. (See also page 79 *et seq* of Bulletin No. 5.)

Carnegie Institution of Washington.

DELTA, ESTUARY, AND LOWER PORTION OF THE CHANNEL OF THE COLORADO RIVER, 1933 TO 1935. Sykes.

This report presents the results of field and laboratory studies together with a digest of other data obtained from various sources which are relevant to recent developments and present conditions in the Delta region of the Colorado

River. The investigation embraces that portion of the river system extending from Boulder Dam to the Gulf of California, and the period covered is from the midsummer of 1933 to the end of 1935, during which time the supply of detritus from the main Colorado drainage system has been gradually cut-off. The investigations include discharge observations at the head of the delta, measurement of quantities of silt transported by the Colorado River to its delta, seasonal fluctuations of silt content of Colorado River, bed silt sampling and analyses, the effect of river control on the movement of bed silt already deposited, bed silt movement and redeposition, mechanical analysis of bed silts, and investigation of characteristic changes in the delta area brought about by the absence of the fertilizing waters of the river flowing over it. The author describes his method of examination and appraisal of the channel bed material, and the improved method of silt sampling used. He gives his interpretation of the observed changes in texture of the bed silts. This study of the first years of the controlled life of the Colorado is of great scientific interest and the conclusions are based on exact quantitative data.

AUSTRALIA.

Council of Scientific and Industrial Research.

A SOIL SURVEY OF THE COOMEALLA, WENTWORTH (CURLWAA), AND POMONA IRRIGATION SETTLEMENTS, N. S. W. Bulletin No. 107. — Marshall. Walkley.

Gives the results of a soil survey of three irrigation settlements in New South Wales.

THE BASALTIC SOILS OF NORTHERN TASMANIA. Bulletin No. 108. — Stephens.

In this report are set out the results of an examination of the basaltic soils of Northern Tasmania.

FURTHER OBSERVATIONS ON SOIL EROSION AND SAND DRIFT, WITH SPECIAL REFERENCE TO SOUTH-WESTERN QUEENSLAND. Pamphlet No. 70. — **Ratcliffe.**

Report of a visit to South Western Queensland made for the purpose of collecting data on wind erosion and sand drift.

INTERNATIONAL CONFERENCES, ETC.

International Commission on Large Dams, World Power Conference.

MINUTES OF THE EXECUTIVE SESSION OF THE INTERNATIONAL COMMISSION ON LARGE DAMS OF THE WORLD POWER CONFERENCE HELD IN PARIS, JUNE 28, 1937.

Contains the minutes of the Executive Session describing the business transacted which includes review of the finances, addition to memberships and other matters of executive concern.

SECOND WORLD POWER CONFERENCE, BERLIN 16—25 JUNE 1930. GENERAL REPORTS.

This publication contains short summaries of papers presented to the Second World Power Conference arranged under different subjects. There is a general report outlining the main points in the papers under each subject and the points for discussion arising out of the papers are also given. The papers generally deal with problems of generation, transmission and use of electricity. There are three papers under the subject of dams. The main points dealt with in the 3 papers are :

The stability of dams.

The discharge of flood water.

Regulations governing the construction of dams.

In the general report on the subject of dams, gravity dams, arch dams, buttressed dams and earth dams are compared as regards their strength and other characteristics.

International Association for Bridge and Structural Engineering.

SECOND CONGRESS OF THE INTERNATIONAL ASSOCIATION FOR BRIDGE AND STRUCTURAL ENGINEERING, BERLIN-MUNICH, 1ST—11TH OCTOBER 1936. PRELIMINARY PUBLICATION.

This publication contains advance copies of papers presented to the Second Congress of the International Association of Bridge and Structural Engineering for the use of delegates and others. The papers are arranged under 8 different heads. Some of the papers under the various heads are mentioned below :

I. Importance of the Toughness of steel for calculating and Dimensioning steel structural work, specially when statistically indeterminate.

There are 8 papers under this head mostly dealing with the theory of plasticity and theory of indeterminate structures.

II. **Stresses and Degree of Safety in Reinforced Concrete structures from the Designer's point of view.**

The following are some of the papers given under this head :—

1. Strength of concrete and reinforced concrete under sustained and frequently repeated loading—O. Graf.
2. Tensile strength and formation of cracks in concrete—E. Bornemann.
3. Tensile strength of stressed parts in reinforced concrete—G. Colonnetti.
4. Practical improvements in the mechanical treatment of concrete—E. Freyssinet.
5. Cracking in reinforced concrete—F. G. Thomas.
6. Use of high grade steel in reinforced concrete—R Saliger.
7. Concreting and dilatation joints in engineering structures—F. Baravalle.

III. Practical Questions in connection with welded steel structures.

There are 25 papers under this head dealing with design and execution of welds with special consideration of thermal stresses, inspection and control of welded joints, and strength and safety of welded structures under load. A number of papers describe experience obtained with welded structures in various countries.

IV. Recent Points of View concerning the Calculation and Design of Bridge and Structural Engineering in Reinforced Concrete.

The following papers are amongst those given under this head :—

1. Solid Domes, cylindrical reservoirs and similar structures.
2. Present day tendencies in large reinforced concrete constructions
3. Wide span reinforced concrete arch bridges.

V. Theory and Research work on details for steel structures of welded and Riveted Construction.

There are twelve papers under this head.

VI. Concrete and Reinforced Concrete in Hydraulic Engineering (Dams, pipe lines, etc.).

The following papers are included under this head :—

1. Development of the Analysis of Arch Dams.
2. The use of concrete in the construction of solid dams.
3. Reinforced concrete piles during driving.

4. **Use of concrete in dam construction in Germany.**

5. **Reinforcement of pressure pipes for the Mareges Dam.**

VII. Application of steel in Bridge and Structural Engineering and in Hydraulic Construction.

The following are some of the papers under this head.

1. Use of steel in Bridge building.
2. Use of steel in hydraulic structures.
3. Welded weirs and sluice gates in Belgium.
4. The steel structures of the hydro-electric plant at Wettingen.

VIII. Research Concerning Building Ground.

The following papers are given.

1. Soil studies for the Storstrom Bridge, Denmark.
2. Subsidence in Bridge Construction on the German State Arterial Roads.
3. Report on Dynamic Soil Tests.
4. Limits of Equillibrium of earths and Loose Materials.

The publication consists of nearly 1,600 pages and a short summary of each paper is given at the end of the paper.

International Union of Forest Research Institutes.

NOTE ON THE OBSERVATION OF THE PHREATIC (SUB-SOIL) WATERS IN HUNGARY (in French). (Paper presented at the IXth Congress. 1936.)

This describes the methods adopted to correlate the exchange of water between the soil and the atmosphere, with particular reference to evaporation, surface run-off, infiltration, and sub-soil flow.

Permanent International Association of Navigation Congresses.

ILLUSTRATED TECHNICAL DICTIONARY. CHAPTER XII—MARITIME SIGNALS.

This illustrated technical dictionary is published in six languages, French, English, German, Spanish, Italian and Dutch. This is Chapter XII dealing with Maritime signals.

International Society of soil science.

LITERATURE RELATING TO "PROPOSALS FOR RESOLUTIONS" AT THE MEETING OF THE SIXTH COMMISSION OF THE INTERNATIONAL SOCIETY OF SOIL SCIENCE (COMMISSION FOR THE APPLICATION OF SOIL SCIENCE TO LAND AMELIORATION) AT ZURICH IN AUGUST 1937.

The proposals for resolutions are in the form of recommendations which were formulated at the meeting of the Sixth Commission of the International Society of Soil Science and relate to the following subjects.

1. Soil and Water. It is recommended that particular attention should be paid to the influence of soil cultivation on soil moisture relations.
2. Drainage Research. To ensure the international usefulness of drainage investigations, the lines on which investigations are to be conducted are laid down.
3. Sprinkling Irrigation and Sewage utilization.
4. Subterranean Irrigation.
5. Classification of peat soils.
6. Liming and Manuring of peat soils.

OTHER PUBLICATIONS.

THE STUDY OF THE SOIL IN THE FIELD. Clarke.

Soil science is a complex study involving many branches of science such as physics, chemistry, geology, botany, etc. One aspect of soil study which is of fundamental importance is the study of the soil in its environment. In the past, this aspect of soil study has been neglected at the expense of laboratory investigations. The author of this book has made it his special study and has endeavoured to put together his own experience and that of other workers so that it may be helpful to students and other workers in the field of soil investigations.

Soil site characteristics and soil profile characteristics are the first things to be determined in a study of the soil in the field. A method for the description of soil site and soil profile characteristics developed by the Oxford Soil Science Laboratory and used with success in many investigations is given. Items which are to be studied in obtaining a complete knowledge of soil site characteristics include age of site, parent material, mode of formation, topograhy, drainage, climate, vegetation, and effect of man's interference and management. Features to be studied for a description of the soil profile are :—Colour, nature of material, organic matter, texture, structure (size and shape of aggregates), mineral skeleton, and special characteristics such as degree of moisture content and pH values.

Each of the above items and features on which information is to be collected is treated in detail and directions for the help of the practical investigator are given. The influence of some of these features in the formation of the soil is discussed. In some cases, there are different systems of classification adopted in England, America and Russia for some of the items under soil profile characteristics. These are set forth and their relative merits and demerits are discussed.

Soil sampling for laboratory examination is the next step after soil site and soil profile characteristics are determined. The method of taking soil samples from the field is described.

The information gathered in the field is placed on permanent record by means of a soil map. The procedure of preparing a soil map is briefly outlined.

Methods of soil survey differ slightly in different countries, but the general principle of all the methods is the same. Soil survey systems in Bavaria, Hungary, Russia, America, and England are described in some detail in the final chapter.

SOIL EROSION AND ITS CONTROL. Ayres.

Soil erosion has become a widespread menace in America. According to an estimate framed in 1935, 35 to 50 million acres of cultivated land are now totally ruined and abandoned as compared to 10 million acres in 1910. Partial to complete stripping of topsoil on 100 to 125 million acres of the remaining cultivated land is estimated. Potentially an area exceeding one third of the entire cultivated acreage of the United States is either totally ruined or will soon be totally ruined unless vigorous and unremitting attack on the menace is resorted to. This boon is a general treatise on erosion control in which an attempt has been made to introduce and correlate all phases of this complex problem.

The three most active eroding forces are water, wind, and ice. Factors affecting rate of erosion are :—rainfall and runoff, soil characteristics, vegetation, and land slope. The effect of these factors on erosion are discussed. The relative value of the different farm crops in preventing soil loss is brought out clearly. The method of making a quantitative determination of run-off from rainfall intensity is explained and graphs giving the run-off for different forest cover and different catchment areas are given. Methods of control on slopes suitable for cultivation and on gullies are discussed in detail. Some of the methods of erosion control on slopes are :—contour farming, strip cropping, terrace cultivation, and planting of pastures. Terracing is dealt with in great detail. Design of terraces, spacing, grading, planning and layout, surveying procedure, terrace construction methods and machinery, terrace costs and maintenance and terrace outlets, are fully treated. Several useful tables for terrace design are included.

Check dams for erosion control in gullies are usually of a temporary character and serve to hold the fill and prevent washing while vegetation for permanent control is becoming established. The design of these check dams is described. For gullies draining watersheds of considerable side, permanent dams are suggested. Various types of masonry and concrete dams are discussed and tables for their design are given. Types of earth dams used are also described. Bank protection of streams and rivers to prevent caving, and bank protection methods in use are described and illustrated. Special use of vegetation and trees in gully control is explained, and suitable species of trees are mentioned.

To secure research data for various erosional areas in the United States, 13 experimental farms have been established. A list of experiments being conducted at one of them is given as a typical example of the work being done at these stations. It is explained how a tentative plan of farming with a view to soil conservation can be arrived at,· and a conservation farming programme to serve as a rough guide is set forth.

STORAGE RESERVOIRS. Williams.

The author in the Preface says : "Many excellent works have been written on the subject of dams and reservoirs but most of them are now out of date. In recent years, enormous structures have been made possible by new methods of design and improved materials. There is obviously room for a treaties that deals with these modern developments".

This book deals with the design and construction of dams and reservoirs. It commences with a chapter on rainfall in which the cause of rainfall. the monsoon, maximum intensities of rainstorms, and the rainfall characteristics of India, Ceylon, the British Isles, Hawaii and the United States of America are discussed. The next chapter deals with run-off and storage capacities. Several methods of computing run-off are described. The practical method of calculating storage capacity is dealt with in some detail and as an illustration an actual example in India is worked out. The question of evaporation and percolation losses from reservoirs is also discussed.

Chapter 3 describes methods of estimating maximum rates of flood flow for various catchments. Formulae for maximum probable rates of flood discharge in various countries are given. The design of spillway capacity for storage reservoirs is treated in detail.

The next four chapters are devoted to the design of various types of dams such as gravity dams, single arch masonry dams, multiple arch dams, reinforced concrete dams, earth dams, and hydraulic and rockfill dams. Relative economic of various types of dams is discussed. Important dams of recent construction are briefly described as well as some which are in course of construction. The principles of design of various types of dams are set forth and a number of useful stress diagrams are included. A comprehensive list containing details of various types of existing dams is given.

A chapter on regulation of storage, reservoir outlets, power stations, irrigation intakes, overflows, and siphon spillways, deals with sluices, automatic spillways, gates of various types, needle valves, and outlets from reservoirs. Arrangements of power stations and surge tanks for hydro-electric schemes are discussed. Two power schemes are described in some detail, namely the Galloway water power scheme, and the Le Sautet scheme in France.

In construction several problems present themselves such as, housing the workmen, disposal of surface flow during construction, disposal of floods, cementation of foundations, and problems connected with mass concrete construction. The methods of detling with such problems are discussed with special reference to some recently completed dams such as the Boulder Dam, the Cauvery Mettur Dam, and the Grimsel Dam.

The chapter on the treatment of water from storage reservoirs used for domestic supplies will be found useful by sanitary engineers.

The final chapter describes a tour round some of the dams and reservoirs of Great Britain.

REINFORCED CONCRETE ARCH DESIGN. Manning.

This book contains new and exact mathematical solutions of problems of various types of reinforced concrete arches. The first seven chapters are devoted to theoretical treatment of problems connected with the symmetrical and unsymmetrical encastre arches, two hinged arches with tied and free ends, and continuous arches on flexible supports. Yielding and sinking of abutments, live and dead load effects, temperature and crown drop effect, spandrel load stresses, and methods of design are dealt with in great detail. Tabulated values are given showing the moment, thrust and shear caused by a load placed anywhere on any kind and shape of arch of any thickness. Some practical considerations affecting the design or selection of any particular type of arch, shrinkage, working stresses, etc., are discussed in one chapter. Three chapters are devoted to the complete design of two encastred and one two-hinged tied arch of 60 ft., 130 ft. and 100 ft. span respectively. In the last two chapters the author deals with the general size and shape of solid abutments in so far as these affect the design of the arch they support, and the general stability of piled abutments. The book offers a complete guide to the designer from the cross section of the gap to be bridged to the details of the reinforcement, and if the method of design outlined is followed step by step, it will give the most economical shape and thickness of arch in any given case.

THE FEDERATION OF INDIA. Lele.

This book is a summary of the Government of India Act of 1935 presented in a simple and general way so as to be helpful to the general public in acquiring a substantial appreciation of the Act.

BUILDING CONSTRUCTION FOR YOUNG ENGINEERS. Khanna.

This book is intended to be a guide to the engineer in the field who is engaged in building construction and gives some practical and sound rules to facilitate rapid determination of dimensions of foundations, walls, floors, roofs, beams, stairs, doors and windows, etc. A chapter on building materials contains a general description of the materials in common use and their characteristics. In the brickwork and masonry section several types of masonry are described. In the chapter on ventilation, a method is given for the determination of the area of the fresh air inlet from theoretical considerations of the quantity of air inhaled and exhaled by each human being and the volume of carbon-di-oxide produced. Miscellaneous hints include instructions for the design of fireplaces, drains, and wells and means of dealing with roof leakages. Some general considerations to be kept in view in house planning are also discussed.

THE PHYSICS OF SOLIDS AND FLUIDS WITH RECENT DEVELOPMENTS, PART II. Prandtl.

This book on hydrodynamics and its applications by the world famous expert on aero-dynamics contains a complete treatment of the subject including a discussion of recent developments. The first chapter deals with equilibrium of liquids and gases and discusses properties of liquids, theory of stresses, distribution of pressure in a liquid, and equilibrium of liquids. The second chapter deals with·the dynamics of frictionless fluids and contains a mathematical discussion of Bernoulli's theorem, motion of a frictionless fluid, momentum theorem for flow, waves on the surface of a liquid and the flow of water in open watercourses. The third chapter deals with the motion of viscous fluids, turbulence, fluid resistance, and practical applications of the theories developed to propellers, windmills, water turbines, ships and aircraft. Viscosity, Reynold's number, the theory of boundary layers, turbulence, eddy formation and its prevention are discussed at length. Flow through straight pipes and watercourses of constant and varying cross sections is treated mathematically and the various practical applications of the types of flow discussed are described. The problems of flow in the cases of ship's propellors, windmills, water turbines, and pumps are analyzed, and the main features of the latest hydrodynamical theory of the turbine problem are discussed. The last chapter is on the dynamics of gases, and represents the lastest developments on the subject.

NOTES ON THE DESIGN AND CONSTRUCTION OF FALLS FOR THE KARACHI SCHEME DISTRIBUTARIES. Reprint from the Transactions of the Engineering Association of Ceylon. Kennedy.

This pamphlet contains a general discussion of the function of falls, their location, control and regulation at falls, protection of the channel and essentials of fall design. The design of notched falls are dealt with in detail and a complete design of two notched fall built by the author is given. Calculations for weir falls, fall with plank crest between two vertical walls and a fall with sluice gate control are embodied in a number of appendices.

COPY OF A LETTER, DATED 2ND AUGUST 1937, FROM MR. KENNEDY, DIRECTOR OF IRRIGATION, CEYLON, TO MR. GERALD LACEY AND THE LATTER'S REPLY THERETO.

Mr. Kennedy informs Mr. Lacey that the Lacey Regime Theory has been adopted in Ceylon in remodelling old channels and constructing new ones, and the improved regime already recorded is an irrefutable testimonial to their practical soundness. He goes on to say that though they have adopted Mr. Lacey's principles there is an element of uncertainty about the selection of the value of "f" the silt factor. They adopt a value of "f" not exceeding 1 and allow a certain degree of latitude as regards choosing a lower value so as to permit the most economical adjustment of the other factors concerned. He explains the reasons of this procedure of selecting a silt factor adopted in Ceylon. He also enquires from Mr. Lacey whether the silt factor depends solely on the size of the silt particles and not on the specific gravity of the silt material.

Mr. Lacey in reply expresses his agreement with the reasoning on which the selection of silt factor has been based in Ceylon and says that the hit and miss principle by which they adopt a working silt factor in Ceylon is better than any ultra scientific method based on silt size alone. He considers that the weight of the silt particles undeniably affects the hydraulic conditions.

STATEMENT FROM SIND COMPARING DISCHARGES BY CURRENT METERS AND VELOCITY RODS.

The statement shows that discharges obtained by velocity rods are usually higher than those obtained by current meters, the percentage difference varying from 1·46 p. c. to 9·7 per cent. in some cases.

STABILITY DIAGRAM OF PARICHA WEIR IN THE UNITED PROVINCES.

The weir is of masonry and is 31 ft. high with a base width of 34·5 and top width of 12 ft. The upstream face of the weir is an arc of a parabola and the downstream face is a straight line with a batter of 7·5 ft. in 31 ft.

AGRICULTURAL DATA OF SUGARCANE AND COTTON IN RELATION TO RAINFALL AND IRRIGATION IN ANAKAPALLE AND COIMBATORE AGRICULTURAL RESEARCH STATIONS IN THE MADRAS PRESIDENCY 1936-37.

Sugarcane of the J. 247 variety was planted on 15th, and 16th April 1936 and harvested on 26th, 27th and 28th April

1937 on sandy loam soil at the Anakapalle research station. The statement shows the dates of application and quantities of irrigation and rainwater to the crop from planting to harvesting, the mean monthly temperature and the yield obtained. A similar statement is included for Cambodia cotton sown on 20th September 1936 at the central farm, Coimbatore the soil being heavy loam with gravelly subsoil.

AGRICULTURAL DATA OF COTTON AND SUGARCANE IN RELATION TO RAINFALL AND IRRIGATION IN RISALEWALLA AND LYALLPUR AGRICULTURAL FARMS, PUNJAB, FOR 1936-37.

These statements show the results of watering experiments carried out at the two agricultural farms. The dates of application and quantities of irrigation and rain water, and the yield and other details are given. The sugarcane experiments were carried out with several varieties.

AGRICULTURAL DATA OF COTTON AND SUGARCANE IN RELATION TO RAINFALL AND IRRIGATION IN MADRAS PRESIDENCY 1935-36.

The statements show details of quantity of water supplied, and the yield for CO 313 sugarcane and Cambodia cotton in connection with irrigation experiments carried out in the Madras Presidency in 1935-36.

AGRICULTURAL DATA OF SUGARCANE AND MAIZE IN RELATION TO RAINFALL AND IRRIGATION IN BIHAR FOR THE YEAR 1935-36.

The statements show the quantity of water used and the yield of sugarcane and maize in Bihar in connection with water requirement experiments.

STATEMENTS SHOWING THE MONTHLY DISTRIBUTION OF RAINFALL MEAN MONTHLY TEMPERATURE AND THE OUTTURN PER ACRE OF COTTON CROP ON THE GOVT. EXPERIMENTAL FARMS AT AKOLA AND NAGPUR FOR 1935-36 AND OF SUGARCANE AT GOVT. FARM DRUG, BILLASPUR AND WARASEONI FOR THE YEARS FROM 1930-31 TO 1935-36.

AGRICULTURAL DATA ON MAIZE GROWN UNDER IRRIGATION IN THE CANAL TRACT OF THE SOUTH CENTRAL DIVISION AND ON THE ARBHAVI FARM IN THE BOMBAY PRESIDENCY FOR THE YEARS 1922-26.

The statements show the quantity of water applied, the mean monthly temperature and the yield obtained.

TWO STATEMENTS SHOWING SUGARCANE VARIETAL EXPERIMENTS CONDUCTED AT THE LYALLPUR AGRICULTURAL FARM, PUNJAB FOR 1935-36.

The statements show the quantity of irrigation and rain water applied, the mean monthly temperature, and the yield for various types of sugarcane experimented upon.

STATEMENT SHOWING SUGARCANE IRRIGATION EXPERIMENT, SHAHJAHANPUR, U. P. 1935-36.

The statement shows the quantity of water applied, the mean monthly temperature and the yield obtained.

AGRICULTURAL DATA OF SUGARCANE AND COTTON IN RELATION TO RAINFALL AND IRRIGATION IN THE PUNJAB PROVINCE FROM 1930-31 TO 1934-35.

The statements show the result of watering experiments carried out at Risalawalla and Lyallpur agricultural farms. The total quantity of water used and the yield obtained are given. The sugarcane experiments were carried out with several varieties.

AGRICULTURAL DATA OF SUGARCANE AND COTTON IN RELATION TO RAINFALL, IRRIGATION, ETC., IN THE MADRAS PRESIDENCY FOR THE YEAR 1932 TO 1935.

The statements show the quantity of water used and the yield of Cambodia cotton and sugarcane as observed in the Madras Presidency.

FLUVIAL MORPHOLOGY IN TERMS OF SLOPE, ABRASION, AND BED-LOAD. Reprint from Transactions of the American Geophysical Union, Seventeenth Annual Meeting 1936. Shulits.

Fluvial morphology is defined as the science of the forms of river beds, their shapes in plan and profile. Existing knowledge with regard to the phenomenon of meandering of streams and changes of profile of streams is generally qualitative but there are some universal quantitative principles of fluvial morphology that have been developed theoretically. The object of this paper is to present firstly a brief statement of some of the qualitative observations and secondly a more detailed statement of several quantitative laws and their use. Some of the qualitative observations are formulated below.

1. The cause of meandering of rivers is the existence of a slope exceeding that required to transport the fine material composing the bed-load. The river flattens its course by meandering.

2. A cut-off results in degradation above the cut-off and aggradation below it.

3. Reduction in bed-load induces a decrease in slope.

4. The river width increases downstream. Investigations of several hundreds of cross sections led Schoklitsch to conclude that the width increases along the stream in direct proportion to the six-tenths power of the yearly run-off.

Some rational morphologic laws are then discussed mathematically, and a number of equations are developed relating bed-load material and abrasion; size of bed-load material and slope of river bed; and bed-load, drainage area, run-off, and abrasion along the course of a river. Schoklitsch's bed-load formula is also discussed. The effects of a river cut-off are analyzed in detail and it is mentioned that the results of the theoretical analysis have been verified frequently in actual practice.

WATER-LOSSES IN HIGH LATITUDES AND AT HIGH ELEVATIONS. Reprint from Transactions of the American Geophysical Union, Fifteenth Annual Meeting, 1934. Horton.

Water losses may be divided into three parts: (1) rainfall interception: (2) transpiration by vegetation; (3) evaporation from the soil. In high altitudes the main source of water loss is evaporation. Some of the salient points, and unsolved problems concerning water losses at high altitudes are outlined in this paper with reference to a number of data of actual observations of losses in a number of basins in the U. S. A. The author has derived an evaporation formula and has explained its use. Evaporation from and condensation on snow and ice, and experiments carried out in this connection are discussed.

AN EXAMPLE OF LONG-RANGE FORECASTING OF PRECIPITATION ON A DRAINAGE-AREA. Reprint from Transactions of the American Geophysical Union, Seventeenth Annual Meeting, 1936. Shulits.

By the method of partial correlations, W. Von Kesslitz has ascertained the relation between the monthly precipitation on the drainage area of the Teigitsch creek in Styria, Austria, and the monthly mean of temperature and barometric pressure for preceding months in the three atmospheric centres of action governing Europe, namely, Iceland, the Azores and Siberia. He has derived correlation equations for precipitation on the Teigitsch drainage area which are reproduced. The computations required several years. The agreement between observed precipitation and that predicted with the aid of the equations is good. He has further prepared equations for the run-off of the drainage area at the Langmann dam by using the correlation method wherein the run-off is related to the rainfall.

THE SCHOKLITSCH BED-LOAD FORMULA. Reprint from "Engineering", June 21 and 28, 1935. Shulits.

The solids transported by a stream consist of suspended matter and other material carried along the bed. The coarser material which is carried along the bed by traction is termed the bed-load. A study of laws governing bed-load is important because it affects the regimen of a river. The erection of a dam in a solid-carrying stream results in aggradation of the bed upstream of the reservoir created, and the regimen of the stream is upset. The Schoklitsch bed-load formula which is considered in this article serves to compute that portion of the total solids load of a river which is transported along the river bed by the tractive force of the stream. The formula states that the bed load quantity moved per unit of time is proportional to the so-called effective discharge which is the difference between the instantaneous discharge and the critical discharge. The rational basis of the formula and the steps leading to its derivation are explained, and the method of determination of the co-efficient in the formula is described. The formula has been verified in the laboratory and in actual streams, and details of these verifications are mentioned. Though developed solely for uniform grain material, the applicability of the formula to mixtures is shown in the article.

FLOW NETS FOR SOIL-SEEPAGE PROBLEMS. Reprint from "Engineering", August 17, 1934. **Shulits.**

This article is a brief statement of Continental European practice in the use of "flow nets" in seepage problems dealing with the methods developed by Forchheimer and Schoklitsch. The network of lines everywhere perpendicular to each other obtained by drawing the stream lines of flow and the equipotential lines or the lines of equal piezometric levels is called a "flow net". The graphical representation of the "flow net" is first explained and an equation representing the law of flow through the net is derived.

The process of determining seepage under a dam by the "flow net" method is then described in detail and another application to a sheet pile cut-off wall is illustrated.

Dachler has used the "flow net" method to compute the seepage from canals and has checked his results experimentally but details of his methods are not given in this article.

THE AQUATIC WEEDS IN DECCAN IRRIGATION CANALS. Reprinted from the journal of Ecology, February 1928. **Narayanayya.**

The serious blocking of irrigation canals in the Bombay Presidency by aquatic weeds led to a study of the weeds and the conditions of their growth since 1915. This pamphlet presents results of the study. The studies concern three important canals of the Deccan canal system namely the Mutha Right Bank Canal, the Nira Left Bank Canal, and the Pravara Left Bank Canal. An idea of the blocking may be had from the fact that the Mutha R. B. Canal discharge dwindles down to 95 cusecs from 420 cusecs when it is full of weeds. The weeds are described and their characteristics are given. The effect of silt in suspension and deposition of silt on the growth of the various weeds is discussed. A section of one of the canals was thoroughly cleared and the sequence of silt deposition and weed growth was studied in the cleared portion. The results are given. Some of the conclusions arrived at are :—

1. Presence or abence of weeds is determined by the deposition of silt.
2. Effect of silt in suspension is not proved. Comparative poverty of aquatic flora in silt laden water can be better correlated with greater velocity and less deposition of silt.

NOTE ON SOIL AMELIORATION AND WATER REQUIREMENTS OF CROPS IN BENGAL. **Gupta.**

Mr. Sen Gupta discusses the fertility of silt in Bengal rivers. The silt of the North Bengal rivers is not so fertile as that of the West and South Bengal rivers. Means of distribution of river silt over cultivated lands in Bengal are discussed. Improvement of soil in Bengal may be effected by deposition of fertilizing silt, application of artificial manure, an improved crop rotation programme and leaving fields fallow.

In the second part of the note Mr. Sen Gupta stresses the need of a study of water requirements of rice as influenced by a change of date of sowing. This study would enable a suitable adjustment of the date of sowing, so that it may be possible to grow both kharif and rabi crops in Bengal instead of only one crop as is usually done in Bengal. A study of suitable crops for introduction in Bengal, their water requirements and economic value is necessary.

BRIEF NOTE DATED 19TH JUNE 1937 TO ACCOMPANY DRAWINGS AND HYDRAULIC CALCULATIONS OF A PROPOSED SILT EXCLUDER ON THE UPPER BARI DOAB CANAL. **Montagu.**

This note describes the hydraulic design of a silt excluder which was proposed for the Upper Bari Doab Canal. The general considerations of design are discussed and detailed calculations and drawings of the silt excluder are attached.

FORMULA REGARDING BACK WATER CURVE AND DRAW DOWN CURVE, 11TH MARCH 1932. **Burkitt.**

A formula for backwater and draw down curve has been worked out for trapezoidal or rectangular channels, and the use of the formula has been illustrated by examples.

COPY OF A LETTER DATED 3RD SEPTEMBER 1937 FROM THE DIRECTOR, CENTRAL IRRIGATION AND HYDRODYNAMIC RESEARCH STATION, POONA, TO SUPERINTENDING ENGINEER, NORTHERN SIND CIRCLE, KARACHI, REGARDING "EXPERIMENTS WITH A MODEL OF THE TANDO MASTIKHAN FALL".

Some experiments were carried out with a 1/16 scale model of the Tando Mastikhan Fall to determine the discharge gauge relationship. The gauge discharge relationship obtained for the model and for the prototype are given and a graph showing correlation between discharge and gauge in model and prototype is attached.

Drought hazard overcome in Arizona Irrigation project with pumps. Reprint from "Western City", August 1936. Hornberger.

Describes some features of an important installation of deep well turbine pump units to provide an auxiliary supply of water for the San Carlos Irrigation Project in Arizona. The scheme consists of 74 wells drilled and equipped with pumping plants. All the wells drilled are 20 inches in diameter, with an average depth of 239 ft. The minimum depth is 154 ft. and the maximum is 480 ft. The wells are all cased with double stove-pipe casing which was perforated after installation. Each pump was intalled in a small circular sheet steel pump house. Pump specifications, efficiency evaluation, and shop and field tests of the equipment are discussed.

Specification No. 1—Reinforced cement plaster lining. Edgecombe.

Describes the procedure to be adopted for lining a watercourse or a channel with ¾ inch thick layer of reinforced cement plaster of 1 to 3 mix.

Copy of letter No. 4260, dated 13th August 1937 from Mr. C. E. Aitken, Superintending Engineer, Deccan Irrigation Circle, Poona, to the Secretary, Central Board of Irrigation regarding "Gunite Lining".

Information regarding the Gunite lining done to the approach channel in Mile 1 and cutting in Mile 7 of the Nira Right Bank Canal is furnished in this letter. The lining was carried out to stop leakage. The gunite consisted of equal parts of fine sand and hydraulic lime which were shot by an air compressor. Actual saving in percolation is not known.

Report on the slips in the earthen embankments of the tanks at Ekruk, Ashti and Waghdad in the Bombay Presidency.

The Ekruk tank was completed in 1869 and the other two tanks in the early eighties. Since their completion, a number of slips occurred in the embankments at different times and remedial measures were adopted each time a slip occurred. This report contains a brief description of some of the serious slips from the date of completion of the embankments to the present day, discusses their probable causes, and describes the remeidal measures adopted in each case. The degree of success achieved with the present remedial measures is discussed.

CORRESPONDENCE REGARDING LINING OF HAVELI MAIN CANAL WITH SODIUM CARBONATE.

Mr. J. D. H. Bedford, Chief Engineer, Punjab, requested Dr. McKenzie-Taylor, Director, Irrigation Research Institute, Punjab, to write a note on the application of sodium carbonate treatment on a large scale in view of the proproposed adoption of the process in lining the Haveli Main Canal. Information was called for particularly on the following points :—

(1) Organizing the work.

(2) Method of application when the soil suitable for treatment exists at site or has to be rehandled.

(3) Definition of clay and method of differentiating it from loam at site.

(4) The actual process that occurs when sodium carbonate makes the soil watertight.

(5) The durability of the process with actual instances if any.

(6) Effect of canal water on the lining.

(7) Wholesale source of supply of soda and the price and quantities required.

Dr. McKenzie-Taylor in reply says that the first step to be taken is a soil survey of the canal alignment to a depth of 2 ft. below designed bed level to determine the reaches suitable for treatment. He states some general rules regarding the relation of soil type and treatment. He then describes in detail the procedure to be adopted in applying the sodium carbonate when the soil suitable for treatment, that is to say, with 15 to 10 per cent. of clay content exists at site, and when the soil with the necessary clay content has to be placed in the bed after removing the soil unsuitable for treatment. As regards differentiating clay from loam, what is required is the determination of the percentage of particles in the soil below ·002 m.m. in diameter, which can be done by a hydrometer. Dr. McKenzie-Taylor then describes the staunching process and mentions that sodium clay is one of the most stable compounds found in nature and there is no better evidence of its durability. The action of canal water on the lining will be negligible for all practical purposes. He suggests that the quantity of sodium carbonate required should be estimated at 100 lbs. per 1,000 sq. ft. of area to be treated. In conclusion, he points out that the treated clay behaves like a jelly and is elastic. Being flexible it will assume the conformation of the underlying soil and is therefore superior to a cement lining.

COPY OF A LETTER DATED 4TH AUGUST 1937 FROM JOSE GARCIA MONTES, DIRECTOR OF INDUSTRIES CUBA, TO THE SECRETARY, CENTRAL BOARD OF IRRIGATION, REGARDING RAINFALL, CROP PRODUCTION AND WATER REQUIREMENTS OF CROPS.

The writer outlines a method developed by him which aims to "express numerically the concept of the efficiency of rainfall as applied to different crops". The benefit of rainfall depends on its absolute amount, its intensity and its opportunity. The amount and intensity are capable of numerical expression but the "opportunity" has never before been expressed numerically. The writer's method gives the "opportunity" of rainfall a numerical expression. For this purpose, the standard water requirements of a crop are first established from sowing to harvesting and correlated to the rainfall as recorded over the same period and a method of statistical analysis is applied to the data. The result obtained is a cypher which takes account of the amount of rainfall as well as its opportunity to the crop and is termed the index of effectivity by the writer.

SOME ASPECTS OF THE TURBULENCE PROBLEM.

Reprint from "Mechanical Engineering",
July 1935. Karman.

The application of rational hydro-dynamics to technical problems is handicapped by the fact that in technical problems the apparently steady motion of fluids is really turbulent, that is to say, subject to irregular fluctuations of velocity and pressure. For technical hydrodynamics, a real theoretical foundation is only possible on the basis of an understanding of turbulent motion. The subject of this article is to review the extent of the present knowledge on turbulence research and especially to review the practical problems connected with this research which may be enlightened by new knowledge in this field. The writer outlines the development of turbulence research from the early empirical methods to the discovery by Reynolds of the laws and fundamental facts of turbulent flow, and the part played by dimensional analysis in the furtherance of this research. He then presents an analysis of turbulent fluid motion by the Enlerian method which considers pressure and velocity at a given point and the Langrangian method which considers the fate of an individual particle, and derives a number of equations representing the theory of turbulent flow. Some practical applications of the concepts are then dealt with which include flow in a closed conduit, flow in rough conduits, flow of a free stream along a surface, effect of turbulent friction on dissipation of velocity differences, problem of heat transfer between a solid and a fluid, and the problem of the distribution of transported sediment through the cross section of a river or a channel

CIRCULAR DATED 8TH SEPTEMBER 1937 FROM THE ENGINEER-IN-CHIEF, ARMY HEADQUARTERS, SIMLA, TO THE CHIEF ENGINEERS OF ALL COMMANDS, REGARDING "GROUND BEARING TESTS—FOUNDATION DESIGN."

A test sheet has been prepared and experiments are ordered to be carried out on the lines laid down. The test sheets are to be completed after carrying out the experiments and returned to the Engineer-in-Chief. From the results of the experiments a table is to be prepared giving the safe bearing srength for average sites in all military stations in India for inclusion in later editions of the M. E. S. Handbook.

THE ECONOMIC IMPORTANCE OF CHANGES IN PLANT COVER. Reprint from the Journal of the Indian Botanical Society, Vol. XVI, No. 4, 1937. Gorrie.

This paper was presented to the Botanical section of the Indian Science Congress, 1937. The similarity of land use problems in India and the United States of America is pointed out. In the U. S. A the need for careful retention of plant cover on all agricultural and waste land which is not actually ploughed has been emphasized. The same holds true for India also. Of the various factors affecting plant cover, grazing is the most widespread and the most insidious. Uncontrolled grazing results in denudation of the vegetation and heavy run-off leading to erosion. Two examples are discussed which emphasize the need of maintenance of plant cover. One is the Uhl River catchment, a detailed survey of the erosion conditions, of which was carried out by the author a short time ago. He discusses the extent and cause of erosion and gives the remedies to be adopted to stop further erosion. The second example is the Pabbi Hills tract in which three distinct areas representing three types of plant cover are to be found. The area under afforestation shows a maximum flood intensity of 100 cusecs per square mile; the area of passively protected forest reserve gives a maximum flood intensity of 600 cusecs per square mile; and the area which is not protected at all and is open to unrestricted grazing gives a flood intensity of 1,600 cusecs per sq. mile. The violent and heavy discharges of these grazed areas causes prolonged flooding in the adjoining flat country and this exaggerates the already pressing problems of rising water table in this tract.

A "CLOSED-CIRCUIT" FLUME FOR SUSPENDED-LOAD STUDIES. Reprint from Transactions of the American Geophysical Union, Seventeenth Annual Meeting, 1936.

Oaks.
Knapp.

The fundamental aspects of suspended load as it affects the dynamics of a stream flow is of great importance not only to hydraulic research but also to the soil conservation service in its study of problems of erosion. One phase of the study of suspended load is the determination of its influence upon the flow characteristics of a stream. A thorough investigation was made with various types of flumes for the study of suspended load problems in the laboratory and ultimately the flume described in this paper was considered the most suitable. The design of the flume and its working are explained in detail.

INFORMATION REGARDING THE METHOD OF STORING WATER BY NIGHT IN THE GEZIRA IRRIGATION SCHEME, SUDAN GOVERNMENT.

In reply to a letter from the Secretary, Central Board of Irrigation seeking information with regard to the method of storing water by night in the Sudan, the Director of Irrigation furnishes some information on the subject based on methods usually adopted in the Gezira Irrigation Scheme. Night storage is only effected in the minor canals. The storage in minors is a practical possibility only because of the uniform layout adopted. The minors are spaced at equal intervals and irrigate on one side only. The field channels taking off the minors are also spaced at equal intervals and water on one side only. The area served per unit length of minor canal is constant. Accommodation for night storage water is provided by setting the banks back thus giving extra width and allowing for a rise in water level above the designed full supply level. A form of regulator is built along the minor every 2·5 kilometres thus dividing the whole length of the minor into a number of compartments. A pipe sluice is set in the wall of the regulator so that water may be passed through the sluice or over the weir at will. In the night, all outlets are closed and the pipe sluices of the regulators are also closed. The water coming into the minor is stored in the first compartment and after filling it, overflows over the regulator wall into the next compartment and so on. Typical sections of night storage canals with drawings of the regulator are given.

ENGLISH EDITION OF THE CLASSIFICATION DECIMALE UNIVERSELLE OF THE INSTITUT INTERNATIONAL DE DOCUMENTATION, VOL. I, FASC 1—AUXILIARY TABLES.

NOTE ON THE CONDITIONS THAT FAVOUR THE GROWTH OF WEEDS, ETC., IN THE ELLORE CANAL, MADRAS May, 3, 1937.

Low velocity of the canal is favourable to the growth of weeds. Moreover when the water is clear and the sun's rays can penetrate easily the rate of growth of weeds is more than when the water is muddy. Weeds are cleared by manual labour periodically and it has been laid down as a rule that silt should be periodically cleared during canal closure so that weeds may be dug up from the roots. Experience has shown that clearance to a depth of 8″ to 12″ is necessary to get at the roots.

INFORMATION ABOUT THE LEAK IN THE FOUNDATION OF THE LLOYD DAM AT BHATGAR. April 1937.

A leak was discovered in the foundations of the dam between the red and black rock met with. Both the rocks are trap rocks but the red rock is somewhat of a coarser nature and is found to deteriorate on exposure to the air. It has also a tendency to split up layers of harder rock above it.

To prevent any possibility of up-ward pressure due to this leak, it is collected into a drain and is given an outlet on the downstream side and a cut off trench is also provided on the upstream side.

WEEDS ON CANALS IN SIND. (Copy of letter No. G-8, dated 24th May 1937 from the Executive Engineer, Southern Dadu Division, to the Superintending Engineer, Western Sind Circle). Mathrani.

Gives his experience of pan grass (Typha elephantia).

Says that this weed grows in clear, shallow and slow moving water and it propagates both through the roots and the seed. Describes experiments with broadcasting "Lari" rice on the berms of the channels for preventing weed growth and says that in the very first year the weed growth was reduced to less than fifty per cent., in the second year to 20 per cent. and in the third year to 10 per cent. Another method for preventing weed growth is given, i.e., to dry the channels, plough them deep, turning over the roots and exposing them to the sun for a few months.

Experiment on the reduction of weed growth on the Main Nira Valley Drain by widening the channel is also described.

POCKET EDITION OF GENERAL CATALOGUE ON WATER WORKS FITTINGS BY GLENFIELD & KENNEDY, LTD. LONDON.

AN UP-TO-DATE SET OF PAMPHLETS ON WATER WORKS FITTINGS BY GLENFIELD & KENNEDY, LTD., LONDON.

LEAFLETS REGARDING PLUMBITE : A MANUAL ON PIPE JOINTING. **Borthwick.**

CATALOGUE ON CHEMICAL CONSOLIDATION AND GROUND-WATER LOWERING BY JOHN MOWLEM & CO., LTD., LONDON.

LEAFLETS ON ALPASTE PARA PROTECTION BY ALUMINIUM UNION OF CANADA, LTD.

ELECTRICAL CONDUCTORS HANDBOOK ISSUED BY ALUMINIUM UNION OF CANADA, LTD.

MAPS, BLUE PRINTS AND PHOTOGRAPHS.

Bengal.

Damodar Canal—Tracing of Anerson Weir, showing Franki concrete pile and steel sheet pile lines.

United Provinces.

Ganges Canal—Two photographs of the Tramway Project.

Ganges Canal Hydro-Electric Scheme—Five photographs in connection with the Nirgajni Power House.

Ganges Canal Hydro-Electric Scheme—Four photographs of the Chitaura Power Station.

Punjab.

Haveli Project—Design of a proposed fall at R. D. 1800 of the Multan Branch. (This is Mr. C. C. Inglis' design).

Bombay.

Shirwata Dam—Stability diagrams. (2 drawings).

Walwahan Dam—Stability diagram.

Takerwadi Dam—Stability diagram.

Mulshi Dam—Stability diagram of the revised section of the dam.

Lloyd Dam—Stability diagram. (3 drawings).

Wilson Dam—Stability diagrams.

Sind.

Two photographs in connection with weeds on canals in Sind.

Indian States.

Karauli State.

Map of Karauli State.

General.

Plan of major levee system along the Mississippi river.

Diagram by Mr. J. S. Kennedy, Director of Irrigation, Ceylon, of Regime Channels by Mr. Gerald Lacey's formulas. July 1934.

NEWSPAPER CUTTINGS.

IRRIGATING KHYBER AGENCY : CONSTRUCTION OF DAM : SCHEME SHELVED FOR FINANCIAL REASONS. 4th July 1937.

Mentions the opinion of the Geological Survey of India on the suitability of the site for the proposed Jaba-Tanga Irrigation Scheme in the Frontier Province. The scheme comprises the construction of a diaphragm wall or an impervious dam across a narrow rock gorge about 250 ft. wide, through which the Khyber river debouches. The rock bed at this gorge is covered by about 30 ft. of bajri sand, shingle and boulders. It was also calculated that there was a subsoil water flow of 50 cusecs and a minimum discharge of 25 cusecs was assumed. The opinion of the Geological Survey of India was sought as to whether the rock was staunch enough for the purpose. Dr. Coulson, who was deputed for the investigation, has given his opinion that the site selected is as good as any other in the gorge.

GUJRAT VILLAGERS' SELF-HELP : DEFLECTING TORRENT INTO ITS OLD BED. 5th July 1937.

Twenty years ago the 'Dwara Kas', a tributary of the Chenab, left its channel about 5 miles above its junction with the Chenab river and cut a fresh channel through the lands of 14 villages, destroying in the process about 6,000 acres of good agricultural land. The villagers, not getting any help from any source, have banded together to supply free labour in the building of an earth bund which it is hoped will deflect the torrent back into its old bed again. The scheme consists of a main bund, some 600 ft. long by 14 ft. high, with 4 spurs of groins which point out into the sandy torrent bed in order to deflect the force of the torrent away from the main bund. The faces exposed to torrent action have to be revetted with a layer of sand bags, and a considerable amount of planting is being done with shisham trees, banha bushes, kana grass clumps, and agave or Spanish bayonet plants in order to bind the sandy soil on and around the bund.

CHIEF ENGINEER RETIRING : FAREWELL PARTY AT SIMLA. 6th July 1937.

Rai Bahadur Bawa Natha Singh, Chief Engineer, Irrigation, Punjab, retired from service, in the first week of July.

RAISING OF DAM AT BIJAPUR : SCARCITY RELIEF MEASURE. 6th July 1937.

The raising of a dam of the Bhutnal Water Works, Bijapur, has been undertaken by the Municipality as a scarcity relief measure. It will cost about Rs. 78,000 and will provide labour for 1,000 people a day for a year.

PUNJAB ASSEMBLY : BHAKRA DAM SCHEME : WHEN IT WILL BE EXECUTED. 10th July 1937.

Questions and answers in the Punjab Assembly, about the commencement of the Bhakra Dam Scheme.

TIMBER FOR HEAVIER STRUCTURES AND SAFER HOUSES. 11th July 1937.

An article by J. N. Zutshi, B.Sc. (Lond.), A.C.G.I., Member of the Iron and Steel Institute, London. Describes the advantages of timber as compared with steel as engineering materials. Besides its usefulness in bridges and houses, he describes its utility in constructing dams of timber.

MANDI SCHEME EXTENSION : BULK SUPPLY TO DELHI ALSO. 13th July, 1937.

Questions and answers in the Punjab Assembly about extensions of electric supply under the Mandi Scheme.

HYDRO-ELECTRIC SCHEME FOR SIND. 14th July, 1937.

The Sind P. W. D. have now in hand a Hydro-electric scheme, under which it is proposed to generate electrical energy at Tando-Mastikhan Fall on the Rohri Canal. The scheme is estimated to cost Rs. 10 lakhs.

SHORTAGE OF FODDER IN U. P. : GOVT. LOWERS IRRIGATION RATES. 15th July, 1937.

To encourage cultivation of fodder, clovers, and grasses, Government have decided to lower the irrigation rates for such crops on certain canals.

TUNGABHADRA PROJECT : SETTLEMENT HOPES. 20th July, 1937.

The favourable discussions between the representatives of the Madras and Hyderabad Governments, have raised a hope that the controversy will be settled.

DOABA M. L. A.'S. DEMANDS : RAISING OF WATER LEVEL : SUGGESTION TO BUILD DAM IN SIWALIKS. 20th July 1937.

The necessity of devising measures to meet the growing menace to agriculture in the Hoshiarpur and Jullundur districts owing to continuous subsidence of the water-level in the Doaba wells was urged by a deputation of the Punjab Doaba M. L. A's. which waited on the Premier and the Revenue Minister. The deputation urged that a dam be constructed in the Siwalik hills to collect flood water during the rains, which would stop the devastation of floods and facilitate irrigation during the dry season.

PROPOSED LLOYD BARRAGE PROJECT FOR KHAIRPUR. 21st July, 1937.

A proposal for a Lloyd Barrage Project for Khairpur State, by which 106 miles of new canals will be constructed and the existing 651 miles of canals remodelled, is understood to have been forwarded to the Govt. of India for sanction. The project is estimated to cost Rs. 69,32,835 and is expected to irrigate about 9,40,230 acres of land.

IRRIGATION PROBLEMS : RESEARCH COMMITTEE'S WORK. 21st July, 1937.

Refers to the Research Committee meeting of the Central Board of Irrigation held in June. Particular mention is made of the land deterioration and reclamation experiments conducted in the Punjab Irrigation Research Institute, with special reference to waterlogging.

PROPOSED NEW CANAL : SURVEY BEING COMPLETED. 22nd July, 1937.

It is learnt that a survey for constructing a canal from Tons river, near Rewa State, for the purpose of irrigating lands in the Allahabad, Rae Bareli, Partabgarh and other neighbouring districts, is being completed. The canal will be fed by lifting water 40 ft. from the river by means of electricity.

DEPENDABLE SUPPLY : DISCUSSIONS ON TUNGABHADRA WATER PROJECT. 22nd July, 1937.

The conference between the representatives of the Madras and Hyderabad Governments about the Tungabhadra waters scheme discussed the question of dependable supply of water at Mallapuram The figures agreed to are given.

WORLD NEWS BY AIR : INDIA'S POPULATION PROBLEM : PLEA FOR ASSISTED EMIGRATION. 24th July 1937.

A brief summary of a paper read by Prof. Radhakamal Mukerjee of Lucknow University before the Royal Society of Arts in London, on Indian population and food supply.

GOING HUNGRY. 27th July 1937.

Editorial notes, on Prof. Radhakamal Mukerjee's paper mentioned above.

SUBSOIL FARMING AND SUBSOIL FORESTRY : WASTEFUL CULTIVATION METHODS : WARNING AGAINST THEIR USE. 29th July 1937.

Describes how the denudation of forests and lack of plant cover cause the washing away of the valuable top soil and leave the poor subsoil for farming and forestry, and warns against such wasteful cultivation methods.

CENTRAL BOARD OF IRRIGATION : MEETING OF RESEARCH COMMITTEE IN SIMLA. 30th July, 1937.

Mentions some of the important questions, including seepage from canals and their treatment, particularly with sodium carbonate, waterlogging, and design of weirs on permeable foundations, which were discussed at the Research Committee meeting of the Central Board of Irrigation in June.

CENTRAL IRRIGATION RESEARCH CENTRE : KHADAKVASLA STATION : PROVINCIAL GOVTS., FOR CONTINUANCE. 6th August, 1937.

The Govt. of India have decided to leave the question of continuing the Khadakvasla Research Station to Provinces and have addressed a circular letter to Provincial Governments regarding this.

THE NEED OF PLANNED ECONOMY : TO SOLVE PROBLEM OF UNEMPLOYMENT : SWADESHI EXHIBITION AT SALEM : MR. V. V. GIRI'S SPEECH AT OPENING. 6th August 1937.

The speaker emphasizes the necessity of planned economy and mentions the objects which such an economic planning should aim at. It includes the introduction of improved methods of agriculture and extension of irrigation.

EROSION MENACE IN PABBI HILLS : LOSS IN REVENUE : HISTORY AND FUTURE OF RECLAMATION WORK. 8th August, 1937.

Review of a pamphlet by Dr. R. M. Gorrie. Describes the reclamation work being done in the Pabbi Hills of Gujrat district, Punjab, and the possibility of future development. The land in this part is being eroded at a rapid pace and although earth bunds and other methods are being adopted to combat the evil of erosion, the author recommends the encouragement of a better plant cover.

PURPOSE OF DAMODAR CANAL SCHEME : ANSWER TO CRITICS : IMPROVEMENT LEVY ON RYOTS JUSTIFIED. 9th August, 1937.

The Govt. of Bengal have issued a Press Note justifying the imposition of improvement levy on the ryots of the area irrigated by the Damodar Canal.

SIND ASSEMBLY : LAND ASSESSMENT IN BARRAGE AREA. 11th August 1937.

It was suggested in the Assembly that a Round Table Conference should be held between the Government and the Zemindars to discuss the question of land settlement.

SIND ASSEMBLY : LAND ASSESSMENT IN BARRAGE AREA : DEMAND FOR VOTING ON AMENDMENT REJECTED. 12th August, 1937.

Two amendments were moved to the official motion to consider the report of the Settlement Officers on land assessment in the Barrage area. One amendment rejected the report and the other recommended revision, pointing out the difficulties of the zemindars paying enhanced rent.

PHOTOGRAPH OF LAKE KHADAKWASLA. 12th August 1937.

This lake is ten miles from Poona. The picture shows the monsoon waters rushing through the sluices of the dam.

SECOND STAGE OF THE PYKARA HYDRO-ELECTRIC SCHEME : RAPID DEVELOPMENT IN MADRAS PRESIDENCY. 13th August, 1937.

As the demand for electricity from the Pykara Station was more than the Station could meet, it is being supplemented by the construction of the Mukurti Reservoir. Water will be accumulated in the reservoir by the construction of a dam and then let down into the natural bed for power production. This dam—the Mukurti Dam—is 90 ft. above stream bed level. The reservoir formed will have a capacity of 1,600 million c.ft. or will give a continuous flow of 185 cusecs for 100 days. The dam is an arched masonry dam of non-overflow type designed for full uplift at points and at the head with a controlled weir 160 ft. long on the left bank. The total height of the dam above foundations is 100 ft. The visible length is 520 ft. and including the core-walls into the hill on both sides is 600 ft. Gives a description of the other engineering features of the dam, *e.g.*, foundations, determination of the safety of the foundations, drainage gallery, spillways, etc. The dam is being constructed in stages. In the first stage the dam was constructed 25 ft. high to store 230 million c.ft. In the second stage the dam is raised to 76 ft. The estimated cost of the second stage is Rs. 21¼ lakhs for the whole scheme, the dam alone costing Rs. 15,24,000.

SIND'S FINANCIAL OUTLOOK : FUTURE WORKING OF SUKKUR BARRAGE. 13th August, 1937.

Notes on the budget estimates for Sind presented to the Sind Assembly. Detailed mention is made of the cost of construction of the Lloyd Barrage, the money loaned to Sind Govt. by the Govt. of India on this account, the possibility of paying off this debt, revenues accruing and expected from the Barrage, etc.

MALAKAND POWER. 13th August, 1937.

A brief account of the Malakand Hydro-Electric Scheme in the North-West Frontier Province. The Station is situated near the Malakand Pass on the heights to the north of the Peshawar Valley and depends for its running on the Swat river. It is really the outcome of the facilities created by the Upper Swat Canal Irrigation Project for the construction of a large hydro-electric power station at exceptionally low cost. The scheme is estimated to cost Rs. 65 lakhs. The work was started in December 1934 and the first stage is expected to be put into operation by the end of this year.

HUGE AUSTRALIAN DAM CRACKED : MENACE TO NEIGHBOURHOOD : 13th August, 1937.

The Burrinjuck Dam in New South Wales is in danger of being destroyed. At present, half the outer surface of the huge wall is wet with seepage water, the worst seepage being at a point where the wall is 80 ft. thick. There are two large vertical cracks in the wall and many smaller ones. Workmen are inserting pipes in the cracks and forcing in cement under pressure.

IRRIGATION DUES : P. W. D. OFFICER CONVINCED OF FARMER'S HARDSHIPS. 14th August, 1937.

The Minister incharge of P. W. D. Bombay has personally investigated the difficulties of the farmers and it is understood that a complete and immediate overhaul of the irrigation policy of the Govt. through changes of rates and the rules governing the collection of rent will be made.

OCCASIONAL NOTES. 14th August, 1937.

Mentions that the Malakand Hydro-electric scheme is nearing completion.

IRRIGATION AND AIRCRAFT. 15th August, 1937.

Some observations on the use of aerial surveys in engineering, which question was discussed at the Research Committee meeting of the Central Board of Irrigation held in June last.

EXPERTS TO STUDY INDIA'S PROBLEMS DECISIONS AT WARDHA : SUGGESTIONS FOR THE CONGRESS MINISTRIES. 18th August, 1937.

The Congress Working Committee has issued a resolution recommending to Congress Ministries the appointment of inter-provincial committees of experts to consider urgent and vital problems, like comprehensive river surveys for the formulation of policy to prevent disastrous floods, utilizing water for purposes of irrigation, problem of soil erosion, eradication of malaria, development of hydro-electric schemes, etc., the solution of which is necessary in any scheme of national reconstruction.

CO-ORDINATION OF RESEARCH. 18th August, 1937.

Emphasizes the need for co-ordination of research in subjects of Provincial concern in India. Particular mention is made of co-ordinating research in irrigation, recommending the establishment of a central research station. It also comments on the working of the Central Board of Irrigation and says "if the Central Board of Irrigation is financed and conducted properly, many lines of research could be carried on".

INDIA LEADING THE WAY : 40 MILLION ACRES IRRIGATED : A WORLD RECORD : SUKKUR AND SUTLEJ PROJECTS. 19th August, 1937.

A general note on irrigation in India, giving figures of development, outstanding features of certain projects in respect to engineering achievements, etc. (This is an official press note, copy of which is also available in this office).

PUNJAB ENQUIRY INTO TUBE-WELL IRRIGATION.
19th August, 1937.

The possibility of introducing tube-well irrigation in the Punjab on a large scale will be investigated by Mr. A. M. R. Montagu, formerly Secretary, Central Board of Irrigation. He has been placed on special duty in this connection.

BENEFITS OF SARDA CANAL SILT: INCREASED OUT-TURN OF CROPS. 19th August, 1937.

The fertility value of silt has been proved by large scale experiments carried out in the Sarda Canal area in the U. P. Certain fields were selected at 27 scattered localities and layers of canal silt, varying from one to three inches in thickness, were spread by manual labour over the fields before the crops were sown. The yield of crops on fields treated like this with that on fields having similar soil conditions but not treated with silt was compared and it was found the silt treated fields yielded 21 per cent. more in grain and 30 per cent. in bhusa.

TRUTH ABOUT IRRIGATION. 19th August, 1937.

Editor's remarks on the general note on irrigation development in India which has been given above.

TUBE-WELLS AND WATER-LEVEL: ENGINEERING PROBLEM IN JULLUNDUR. 20th August, 1937.

A hydro-electric scheme—the Jullundur Hydro-electric Scheme—consisting of five separate projects was prepared to the minutest detail but has been held up owing to the difference of opinion among engineers as to whether or not the water-level in the soil will decrease as a result of its exhaustion by tube-wells. A conference of heads of the engineering departments is being convened soon so as to reach a final decision.

HAVELI PROJECT: WORK TO BEGIN NEXT OCTOBER.
21st August, 1937.

Work on the Haveli Project in the Punjab is expected to commence next October. Mr. F. F. Haigh has been appointed Superintending Engineer, R. B. Ajudhia Nath will hold charge of headworks division and R. S. Lala Kanwar Sain has been appointed Director of the Central Designs Division.

WORK WITH MODELS: INTERESTING EXPERIMENTS ON WATERWAYS. 21st August, 1937.

Mentions some model experiments conducted at the Karachi Irrigation Research Station. These experiments include the questions of scour downstream of regulators and falls, remodelling a regulator to be fitted with vertical screw gates in place of vertical needles, eliminating bends in canals, and providing an off-taking channel with the benefits of a cross regulator on the parent channel.

EXTENDING TUBE-WELL IRRIGATION : INQUIRY INTO SYSTEM : POSSIBILITIES OF EXPANSION IN THE PUNJAB. 21st August, 1937.

Mr. A. M. R. Montagu, formerly Secretary, Central Board of Irrigation, has been appointed officer on special duty to investigate the possibilities of expansion of tube-well irrigation in the Punjab, particularly in areas where water-level of the soil is high.

USE OF TUBE WELLS : IRRIGATION SCHEME FOR PUNJAB. 21st August, 1937.

Same as above.

OUR ORISSA LETTER : HAVOC WROUGHT BY FLOODS : DEMOLITION OF EMBANKMENTS. 22nd August, 1937.

Mentions the causes of floods in Orissa and suggests certain remedies. Among the causes, is mentioned the effect of embankments and anicuts. It is stated that these embankments and anicuts stem the flow of water which causes deposition of silt in the river bed and thus causes decrease in the capacity of the river to carry water. It is suggested that (1) the embankments and anicuts should be demolished, (2) a permanent Orissa Flood Relief body be set up, and (3) and inter-provincial board be set up to control and regulate the waters of the Mahanadi, which river is the chief cause of floods.

TUBE-WELL IRRIGATION. 22nd August, 1937.

Mentions the appointment of a special officer to investigate possibilities of tube-well irrigation in the Punjab.

SALT-AFFECTED LAND : AERIAL SURVEY RECOMMENDED. 22nd August, 1937.

The Punjab Waterlogging Board is understood to have decided that in future aerial surveys should be conducted to ascertain the extent of waterlogging and salt-affected lands.

HAVELI PROJECT : WORK TO BEGIN NEXT OCTOBER. 22nd August, 1937.

RESEARCH WORK IN IRRIGATION : USE OF MODELS : VALUABLE EXPERIMENTS IN INDIA. 24th August, 1937.

Mentions irrigation research by models being done in the various Provinces. Experiments mentioned include design of weirs on permeable foundations, prevention of scour below barrages, weirs, falls, etc., silt prevention in channels, seepage control, river training, subsoil water level, etc. (This is an official press note issued by the Director, Public Information, Govt. of India, copy of which is also available in this office).

IRRIGATION RESEARCH: FURTHER EXPERIMENTS WITH MODELS OF WORKS: EROSION PROBLEM. 25th August, 1937.

Same as above.

SOIL RESEARCH: EXPERTS TO VISIT KOTRI THIS WEEK. 25th August, 1937.

Rao Bahadur B. Viswanath, Dr. McKenzie-Taylor, and Dr. Basu are to visit the Soil Research Laboratory at Kotri (Sind) to see the nature of the work in the laboratory and to suggest means for improving its activities to benefit cultivation in the Barrage area.

CURRENT TOPICS: LOSS THROUGH SEEPAGE. 26th August, 1937.

Mentions the danger of seepage from canals and suggests that, although it may be difficult in the case of big canals, iron or earthenware pipes can be used in case of small canals which will minimize the danger from seepage and water-logging.

POWER AND PROGRESS. (Specially written for the "Statesman" by Sir William Stampe, Kt., C.I.E., Chief Engineer, U. P.). 1st September, 1937.

A general article describing the need for development of power, sources of development, and its economic benefits, with particular reference to conditions in U. P.

IRRIGATION BY TUBE WELL: MODERN METHODS OF OBTAINING WATER SUPPLIES: THE VALUE OF INDIVIDUAL WELLS. 1st September, 1937. (By H. A. H.).

A general article describing the advantages of tube-well irrigation over canal irrigation, area that can be served by a tube-well, consideration of the cost of pumping, etc. Refers also to the Ganges Valley Scheme which is the largest tube-well scheme in India.

MAP MAKING WITH A CAMERA: AERIAL PHOTOGRAPHY IN INDIA: VAST SAVING IN TIME AND LABOUR. 1st September, 1937.

A general article describing the advantages of aerial photography in surveying.

ELECTRICITY IN SOUTHERN INDIA : PROGRESS OF THE PYKARA SCHEME. 1st September, 1937. (By Fred Barrie).

The article describes the Pykara Hydro-Electric Scheme in Madras. It gives description of the catchment, runoff, storage facilities, the first stage of the Pykara scheme as well as the Mukurti Dam and Reservoir which is meant to supplement the Pykara supply. Gives the engineering features of the system. Says "it is the highest head plant in the British Empire, not excluding North and South America". It is also said to be one of the five highest head plants operating anywhere in the world.

OUR ORISSA LETTER : A PERMANENT REMEDY FOR FLOODS : ORISSA BUDGET. 4th September, 1937.

At a meeting at which the Orissa Governor presided the need of a permanent remedy for combating the flood evil was stressed and it was suggested that an Embankments and Drainage Division, independent of the Irrigation Department, be instituted to expedite action on the recommendations of the Orissa Flood Committee of 1928.

BOON TO BENGAL CULTIVATORS : DAMODAR CANAL : CROPS SAVED IN YEAR OF DROUGHT. 5th September, 1937.

Gives the history of the origin of the idea of constructing this canal and its advantages.

IRRIGATION : HOW PROBLEMS OF VITAL IMPORTANCE ARE DEALT WITH AT LAHORE. (By. Dr. E. McKenzie-Taylor). 5th September, 1937.

An illustrated article describing the work done at the Punjab Irrigation Research Institute at Lahore. The problems investigated include waterlogging, seepage and its treatment with sodium carbonate, the construction and protection of weirs, design of structures on permeable foundations, soil deterioration, and the control of silt in canals. Experiments with models are an interesting feature of the activities of the Institute. A safe design of weirs on permeable foundations has been evolved and the reconditioning of the Merala Weir in the Punjab and of the Damodar Weir in Bengal have been based on these results. Trimmu Weir, the headworks of the Haveli Project, is being designed according to this design.

EROSION THREAT TO PUNJAB: CANALS SILTING UP. 7th September, 1937.

The Irrigation Branch, Punjab, has been collecting data on the silt carriage of Punjab rivers and have now come to a definite conclusion that the enormous load of silt—the result of erosion in the foot hill of Jammun and Gujrat—has decreased the carrying capacity of the Upper Jhelum Canal by 40 per cent even with the installation of several silt ejectors at a heavy cost. Dr. R. M. Gorrie gives the causes of this erosion and suggests forest conservation and diminution of potato cultivation and grazing, as the remedies.

CONTROL OF INDIA'S WATERWAYS: RESEARCH SUCCESS: OVERCOMING EFFECTS OF EROSION. 7th September, 1937.

Describes some experiments on river training, storage reservoirs, design of falls, weirs, etc., which have been carried out at the Hydrodynamic Research Station at Khadakvasla.

FLOODS IN U. P.: PLEA FOR RIVER SURVEY AND TRAINING. (By. Ch. Mukhtar Singh). 8th September, 1937.

A general article giving causes of floods in U. P., and their prevention. Advocates proper river training and river survey for the purpose.

TUBE-WELL IRRIGATION IN BUDAON: ADVANTAGES THAT PEASANTS CAN DERIVE FROM POWER: TOUR OF MINISTER OF COMMUNICATIONS. 10th September, 1937.

The Minister for Communications, U. P. presided at a well attended meeting of the Budaon district officials, irrigation officers and zemindars, Sir William Stampe, Chief Engineer, U. P., was also present and explained the hydro-electric development in Budaon, which is one of the western districts of U. P. (A press note by U. P. Government).

SURVEY OF CROPS AND SOILS IN INDIA: AGENDA FOR NEXT MEETING: PUNJAB GOVERNOR TO OPEN DELIBERATIONS. 10th September, 1937.

The second meeting of the Crops and Soils Wing of the Board of Agriculture and Animal Husbandry in India will be held from December 6 to 11 at Lahore. The agenda consists of review of soil survey work in India up to date, the theory and practice of manuring in India, work on the improvement of bullock-drawn implements, plant breeding, water requirements of crops, etc.

SUBSOIL DRAINAGE IN SIND : AREAS INVESTIGATED. 10th September, 1937.

Important investigations in connection with subsoil drainage have been carried out in Sind. It has been found that the spring level in Sind is more or less steady and that the subsoil water which had a high salt content before the opening of the Lloyd Barrage Canals has become diluted to some extent since the introduction of perennial irrigation.

CURRENT TOPICS : HYDRODYNAMIC RESEARCH. 11th September, 1937.

Commenting on the press note regarding work being done at the Khadakvasla Research Station, says that "with many calls on the provincial finances it will be quite fit, if research of the kind is conducted by Central Government".

DETERMINED ATTEMPT TO ACHIEVE UNITY : PUNJAB PREMIER'S WARNING TO COMMUNALISTS : SPEECH AT SIMLA : TIRADE AGAINST DR. SATYAPAL. 13th September 1937.

In his Speech, the Punjab Premier also referred to the Haveli Project saying that a sum of 68 lakhs has been provided for the Haveli Project during the current year.

WORLD NEWS BY AIR : ENGLISH GRASS TO CHECK SILTING : TESTS WITH CUTTINGS. 14th September, 1937.

Mr. B. L. Suberwal, Dy. Chief Engineer, Bengal Irrigation Department, who had gone to England on holiday is bringing with him rice grass cuttings with the hope that if climatic conditions favour its growth in India, it may prove to be useful for checking silting. Rice grass is a salt water plant which when cultivated in large quantities checks the flow of silt carried in the water and causes the silt to be deposited. Under best conditions, it sometimes raises the level of the land by a foot a year.

IMPROVEMENTS AT THE METTUR DAM. 17th September, 1937.

Brief description of some novel works recently constructed at the Mettur Dam. (See Quarterly Bulletin No. 6, pages 10 & 11).

350 YEAR OLD PLAN : ANCIENT ORIGIN OF METTUR PROJECT. 20th September, 1937.

Sir C. P. Ramaswami Ayyar, Dewan of Travancore, disclaims the honour attributed to him of originating the Mettur Dam Project and says that it was thought of by the great Cholas 350 years ago.

Subsoil water: Important Factor in Irrigation. 21st September, 1937.

Mentions some experiments carried out on soil and irrigation research by the Irrigation Research Division at Poona and Baramati. These experiments comprise the study of typical soil profiles, the physico-chemical changes caused by irrigation and high subsoil water-levels, and the reclamation of soil tilth in damaged lands after drainage. It has been found that irrigation damages some types of soils and benefits others, the depth of the subsoil water being an important factor. Gypsum has been found to be of considerable value for improvement of soil tilth as compared with lime and sulphur. Dhaincha has been found to be most suitable as green manure and nilva as the best fodder crop.

Occasional Notes. 21st September, 1937.

New uses of cotton have been found for cotton in the U. S. A. They include the reinforcement of asphalt lined irrigation canals and of the banks of dams and reservoirs, the covering of seeding lawns and terraces, etc.

Cheap Electricity for East U. P.: Grid discussions: Cost of water from tube wells. 22nd September, 1937.

The U. P. Hydro-Electric Scheme was discussed by U. P. M. L. A's. with the Chief Engineer. Objections, both economical and technical were raised and Sir William Stampe, the Chief Engineer, replied to them all.

Irrigation Research at Poona. 22nd September, 1937.

Same as the cutting "Subsoil Water . . . ." dated 21st September.

Flood situation in Orissa: Mr. Andrew's appeal for relief. 23rd September, 1937.

Recommends three things immediately required in addition to relief. (1) Malarial survey of Orissa after flood water has subsided. (2) Agricultural inquiry in order to find out the possibility of making a better use of very fertile delta soil outside flood season, (3) Aerial survey by means of aeroplanes not only in Orissa itself but also along the upper courses of Mahanadi and its tributaries. He further says that these will lead to the formation of an inter-Provincial Board working in close co-operation with the Central Board of Irrigation.

U. P. IRRIGATION BUDGET. 23rd September, 1937.

Editor's remarks on the U. P. Hydro-Electric Project advocating the extension of electric development.

CURRENT TOPICS : HIS HUMILITY. 23rd September, 1937.

Refers to Sir C. P. Ramaswami Ayyar's disclaim of the honour attributed to him about originating the idea of the Mettur Dam, and says that although credit is given to the British Govt. for various schemes in India, but if closely examined they will be found to have been planned a long time ago.

IRRIGATION SYSTEM OF INDIA : LEAGUE REPRESENTATIVE TO STUDY. 26th September, 1937.

Mr. Shih-Ta Hsu, a Member and Engineer-in-Chief of the North China River Commission, Tientsin, has been deputed by the League of Nations to visit India and study the great irrigation systems in the country.

BOMBAY COUNCIL : IRRIGATION WORKS. 26th September, 1937.

The Minister for P. W. D., Bombay, in response to a question in the Bombay Assembly, said that the present needs of Gujrat as regards irrigation were being investigated and that the Govt. was also considering participation in the Sabarmati Irrigation Scheme being mooted by the Baroda Darbar.

IRRIGATED LAND : BIG INCREASE RECORDED IN PUNJAB. 26th September, 1937.

Gives figures of increase in irrigation in the Punjab.

RYOT'S GRIEVANCES : PREMIER'S ASSURANCE TO CANE GROWERS. 26th September, 1937.

A deputation of cane growers waited on the Minister for P. W. D., Bombay, urging revision of agreements and reduction of water rates.

THE SARDA CANAL IN U. P. : MAGNITUDE OF ITS UNDERTAKING. 27th September, 1937.

An outline of the Sarda Canal system in U. P. giving extent of irrigation and engineering features. Photographs of certain interesting engineering structures are also given.

LOSS DUE TO SEEPAGE. 28th September, 1937.

Mentions that experiments conducted in U. P. show that treatment with sodium carbonate can reduce seepage losses by about 35 per cent. The cost is said by about Rs. 0-15-0 per hundred square feet.

FLOOD CONTROL IS POSSIBLE : AMERICAN EXPERT'S VIEWS. 29th September, 1937.

At a recent conference of those interested in flood control Dr. Bennett, Chief of the Soil Conservation Service, U. S. A., emphasized the necessity for better soil husbandry for prevention of floods. Dr. Lowdermilk explained the run-off characteristics of small and large areas.

M. T. GIBLING,
Secretary,
Central Board of Irrigation.

GIPD—L223 Secy. CBI—1-11-37—1,100.

GOVERNMENT OF INDIA

CENTRAL BOARD OF IRRIGATION

QUARTERLY BULLETIN NO. 8.

OCTOBER TO DECEMBER, 1937.

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SIMLA,
15TH JANUARY, 1938.

The Government of India and the Central Board of Irrigation are not responsible for the statements made or opinions expressed herein.

CENTRAL BOARD OF IRRIGATION, 1937.

Sitting :—Mr. A. Gordon. (Sind.) Mr. T. A. Curry. (Bengal.) Mr. G. M. Ross, C.I.E. (N.W. F. P.) (*President*). Mr. M. R. Richardson, C.I.E. (United Provinces.) Mr. T. A. Andrew. (Bombay.)

Standing :—Mr. M. T. Gibling. (*Secretary*.) Mr. T. M. Lyle, C.I.E. (United Provinces.) Mr. S. H. Bigsby, C.I.E. (Punjab.) Mr. F. M. Dowley. (Madras.) Mr. F. A. Farquharson, M. C. (Punjab.) Capt. G. F. Hall, M.C. (Bihar.)

Office of the Secretary,

Central Board of Irrigation,

Simla, H. O.

QUARTERLY BULLETIN No. 8.

OCTOBER TO DECEMBER 1937.

The Board.

The 8th annual meeting of the Board was held in Delhi from the 30th October to the 4th November 1937. The President of the Board, Mr. G. M. Ross, C. I.E., opened the proceedings. The following are extracts from the President's address :—

> " Eight years ago when the Central Board of Irrigation was constituted we dealt with purely irrigation matters. Since then the scope of the Board has extended and its importance to India increased. We now deal with many allied subjects such as Agriculture, Soil Research, Public Health, Flood Control, Hydro-Electricity, etc., all of which are of vital importance to India as a whole and are subjects on which the advice of Irrigation Engineers is freely sought.
>
> The question now arises as to whether we should change or add to our name, so that the general public may realize that we deal with these subjects. At present they look on us as dealing with Irrigation alone. It is difficult to get a title that is comprehensive and short. I would suggest the designation be changed to the Central Board of Irrigation and Allied Sciences.
>
> Our work is increasing rapidly. When we opened our office in the first instance, our staff consisted of one Secretary *plus* two clerks. It now consists of one Secretary, one Assistant Secretary and 7 clerks, and I anticipate that in the near future further increases will be necessary.
>
> During the year we have held two meetings of our Research Officers instead of one as in former years. The extra meeting was an informal one held in Lahore at the time of the Annual Meeting of the Punjab Engineering Congress. This meeting was an unqualified success and I trust that it will become an annual feature in the future.
>
> The main meeting of our Research Officers which was very well attended was held in Simla in June. Discussions were long and vigorous and there can be no doubt that they were of the greatest benefit to those present and to the whole profession. Although by no

> stretch of the imagination could I claim to be a Research Officer, I am intensely interested in the subject and consider it to be one of the most important of the activities of the Central Board of Irrigation. "

In addition to the President's suggestion, a proposal to re-designate the Board as the " Central Board of Irrigation, Hydro-Electricity and River Control " was considered, in view of the fact that some authorities and sections of the public are under the impression that the Board's activities are confined to irrigation only. It was decided not to accept the proposed designation as it was too cumbersome, but to bring to the notice of the authorities and the public, the extent of the Board's activities.

A proposal to hold subsequent meetings of the Board at Provincial Capitals and to invite the Governor of the Province concerned to open the proceedings, was discussed. As it was feared that only a few of the Members would be able to attend the meetings if they were held at considerable distance from their headquarters, and that it was desirable to have as full a gathering as possible, it was decided that the Board meetings should continue to be held in Delhi.

In connection with the problem " Staunching of Canals ", the Sodium Carbonate method was discussed at length. Canal beds and side-solpes often contain a proportion of calcium clay, which is previous. If it is treated with sodium carbonate, the calcium clay is converted into a sodium clay which is impervious to water. The clay takes the form of a jelly, and as water alone can change the clay in its new form, and it is impervious to water, the effect is permanent. As this provides a cheap method of staunching canals, investigations have been undertaken in the Punjab, United Provinces and Sind, to ascertain the most efficient and inexpensive method of applying the treatment. Application of the sodium carbonate in a dry form and also as a solution has been tried, but no definite decision as to which is the better method, has yet been reached. Dr. McKenzie-Taylor informed the Board that in his opinion, the wet method is the better as it is not affected by wind and a more even application of the sodium carbonate is obtained.

In a laboratory test at the Punjab Research Institute, a 4″ thickness of clay was rendered watertight by the process, even under a head of 13 ft. of water. Field tests in the United Provinces have produced staunching up to 40%, whereas their laboratory experiments have shown as much as 60% staunching. A sodium carbonate lining is considered to be superior to concrete in areas where the sub-soil water level is high, since it is flexible and will withstand the pressure without cracking.

From actuarial analysis in the United Provinces it has been concluded that it is more economical to line the parent channel than to line the " gul " (watercourse) system, and that no form of lining except sodium carbonate is financially justifiable.

Difficulty has been experienced in getting the sodium carbonate applied to the canals in the time at disposal in an ordinary closure, and it has not been possible so far to measure the extent of the benefit from the treatment since the inaccuracies involved in measuring discharges with current meters are likely to amount to the reduction in losses effected byt he treatment. The benefit to a channel is being gauged from the quantity of water available at its tail after treatment, compared with that available beforehand. The Board passed the following resolution in connection with the sodium carbonate method of lining :—

> *Resolution.*—This Board is of the opinion that the further experiments carried out with sodium carbonate have indicated that the treatment is cheap and effective in rendering canal beds less pervious. The Board recommends that further experiments on as large a scale as possible be carried out, and the results reported to the Board.

Mr. Edgecombe informed the Board that investigations were in hand in the United Provinces to ascertain whether molasses is an effective medium for waterproofing channels. Laboratory experiments have proved very satisfactory and they are to be extended to the field. If molasses is found to be suitable for this purpose it will provide a good use for a by-product of sugar cane factories which at present has very little value.

To measure absorption losses in the United Provinces canals they measure discharges over calibrated weirs with automatic gauges. A period of about a week, over which the charts show steady discharges, is selected, and the volumes of water passing the upper and lower sites are calculated ; the difference being the losses. When calibrating the weirs, they take as many discharges as possible in order to eliminate errors. If there is an error of 3% in one observation, there will be an error of 1% only from the results of 9 similar observations. When calibrating the weirs they measure the discharges with rods.

Arising out of the question " Means to secure the Equitable Distribution of Irrigation Water ", is the problem of the water requirements of crops, and during the discussions, Mr. Montagu informed the Board that investigations undertaken by him in connection with tube wells, indicated that for irrigation from wells, cultivators used about half the quantity of water that is used from canals, and at double the cost. Closely allied to the water requirements of crops is the question of the manurial vlaue of silt. It has been estimated that in some areas in Bengal, a single watering from the canals is worth eight annas per acre from the manurial value of the silt alone.

The Board passed the following resolution :—

> *Resolution.*—This Board is of the opinion that the question of water requirements of crops and manurial value of silt is of great importance, and should be one of the first investigations undertaken at a Central Research Station for Irrigation, if and when established.

During the discussion or the question " The fair incidence of the cost of irrigation water on different classes of crops ", Mr. Gordon suggested that some system of assessment might be introduced which would encourage good cultivation. For example, it is highly beneficial to grow " guar " along with cotton, and cultivators might be encouraged to adopt the practice by lowering the assessment for the mixed crop, or by raising the assessment for cotton alone.

The following resolution in connection with the design of canal falls was passed by the Board :—

Resolution.—It is resolved that Mr. Inglis's Report on the Design of Canal Falls should be examined by the Research Committee at its next meeting with a view to the Report being issued as a Board publication.

The Board accepts the opinion of the Research Committee that comprehensive research into the subject of the design of canal falls is desirable, and that until such research has placed the principles of design beyond dispute, it is inadvisable to record any recommendation in favour of any type of design for general application. The Board also accepts the Research Committee's opinion that wide publicity should be given to the results obtained by officers engaged in this line of enquiry.

The Board approved of the following new subjects being taken up for investigation by the Research Committee next year :—

(1) The Collection of Hydraulic Data of torrents in Boulder Rivers and Streams.

(2) Silt Excluders and Ejectors.

(3) The Preparation of a Guide to the collection of Statistics.

The following resolution in connection with the design of works on permeable foundations, was passed :—

Resolution.- This Board desires to place on record its appreciation of the very valuable work done by Rai Bahadur Ajudhia Nath Khosla, Dr. N. K. Bose and Dr. E. McKenzie-Taylor, the authors of Board Publication No. 12 entitled " Design of Weirs on Permeable Foundations ", and to convey its thanks to those officers, and to the Punjab Irrigation Department for the opportunity of publishing the results of the investigations in the form of a Board Publication.

The following resolution regarding the design of channels in alluvium was passed :—

Resolution.—The Central Board of Irrigation wishes to draw the attention of the Government of the United Provinces to the difficulty engineers in India are faced with when applying the results of Mr. Gerald Lacey's work to the practical design of channels in alluvium. Mr. Lacey's work is of incalculable potential value to them, but is not easily accessible as it is scattered in several publications. Because of this difficulty, India as a whole is not profiting from this officer's work to the extent it should do and the Government of the United Provinces would be doing a great service to the engineering profession as a whole and, in view of the importance of irrigation, to India and especially to the Indian cultivator, if they could see their way to place this officer on special duty for such a period as may be necessary to allow him to write up for publication by the Board a complete note on his researches.

Such a publication would also have the great advantage of focussing attention to divergences of views on details of application known to exist among irrigation engineers. It would stimulate further research in this most vital subject.

After discussing the problem of flood control the Board passed the following resolution :—

Resolution.—The Central Board of Irrigation desires to draw attention to the Proceedings of the British Empire Forestry Conference, South Africa, 1935, with particular reference to the possible dangerous effects of deforestation on irrigation in India.

These effects are :—

(*a*) the increase of intensity of floods,

(*b*) the decrease of the dry weather flow in rivers.

The former would mean greater capital expenditure and more expensive maintenance on canal headworks, thus possibly making otherwise productive projects unproductive, and difficult to finance. The possibility of damage to existing works should also not be overlooked. In addition, and what is most important of all, there is the greater tendency to flooding of vast tracts of country.

A decrease in the dry weather flow of rivers would have most serious effect on those cultivators who rely on canal supplies to mature their crops. Even those who rely on irrigation from wells might be affected by lowering of the sub-soil water table.

These detrimental effects have already been noticed in some of the smaller river basins. Although there is no absolute proof of the larger rivers yet having been affected by deforestation, the Board is of the opinion that India cannot afford to neglect the experience of other countries.

The problem is not usually a Provincial one, as most of the basins of larger rivers lie in more than one Province or State, and deforestation in one administration may produce most serious results in another.

The Forest Department has from time to time drawn attention to the dangerous effects of deforestation on rivers, and the Board desires to endorse those warnings.

The Board also decided to collect information regarding the existing river and rain gauging stations, and data available, with a view to recommending the establishment of further such stations if found necessary, and the co-ordination of the collection of data.

Sir William Stampe addressed the Board on " Inter-Provincial Power Development in India ", and a general discussion on hydro-electric projects followed. The Board passed the following resolution :—

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Resolution.—The Board has observed that in certain provinces where hydro-electric undertakings are in operation and commercial

accounts are kept, the sums which are annually debited against the maintenance of the scheme on account of depreciation are not funded but are merely kept in floating deposit in the provincial budget surplus. In view of the fact that depreciation funds are supposed to be maintained for the replacement of particular items of machinery after a period of years and annual debits are based on the period of years thus assumed, the Board feels that any sums debited against the revenue accounts of such projects should be credited to a separate depreciation fund which should be kept either with the Controller of Currency or invested in definite securities. Any sum that may accrue in the form of interest on such securities should be credited to the general revenues of the scheme and shown as revenue in the pro-forma accounts.

Should any disaster happen to the scheme as a whole or to any of the power stations as a result of floods or other natural cause, the depreciation fund should be available as a separate entity from which to finance the replacement of machinery thus damaged. The Board trusts therefore that provinces will adopt the principle of funded depreciation accounts for these reasons.

During the discussion on the " Questionnaire on conditions predisposing to harmful soil saturation which may ultimately result in waterlogging ", the important fundamental probblem of the extent to which rain, seepage from canals, and water applied to the land, were responsible for the rise of the sub-soil water table, evoked considerable discussion. Investigations are in hand in the Punjab, United Provinces and Sind, which may lead to the solution of this problem.

Members of the Board and other officers attending the meeting visited the Imperial Agricultural Research Station at New Delhi.

On the 2nd November the Board attended the opening ceremony of the Chitaura Power Station, which was performed by His Excellency the Governor of the United Provinces. Other works connected with the Ganges Hydro-Electric and Tube-Well Schemes were also visited the same day.

The question of establishing a Central Research Station for Irrigation was discussed at length by the Board, particularly in relation to the following recommendation contained on page 220 of Sir John Russell's report on " The Work of the Imperial Council of Agricultural Research in applying Science to Crop Production in India, 1937 " :—

" *Improvement of the water supply for crops.*—This is one of the most important of all agricultural problems in India and perhaps the most difficult. It is too big to form part of a programme, and I recommend the establishment of a Central Irrigation Station for all-India where the agricultural problems can be worked out. At this station the relations of soils, water, and growing crops would be studied, also the interaction between salt water and soil, the reclamation of salted and alkaline land, the movements of subsoil water, and the agricultural effects of various sequences of crops.

Provision should also be made for more complete co-ordination of the investigations on dry farming, and for linking it up with the work of the proposed Irrigation Research Station ".

The Board passed the following resolution by a majority of six votes to four :—

Resolution.—This Board is of the opinion that a Central Irrigation Research Station equipped to investigate irrigation problems and also all agricultural problems associated with irrigation, as recommended by Sir John Russell in paragraph 3, page 220 of his report, is essential.

2. The Station should be financed by the Government of India for the following reasons :—

(*i*) Irrigation is of all-India importance and large revenues accrue therefrom to the Central Government.

(*ii*) The Government of India at present make no contribution towards Irrigation research in India whereas they support to the extent of many lakhs of rupees Forestry, Agriculture, Veterinary research and Industries. To mention only two examples, the Forest Research Institute at Dehra Dun, and the Agricultural Research Institute at Pusa, the cost in 1933-34 amounted to Rs. 6·05 lakhs and Rs. 7·63 lakhs respectively.

(*iii*) The Provinces finance their own Irrigation Research entirely and receive from the Central Government no contribution, such as is provided by them for research in other subjects.

(*iv*) Except for a small contribution from the Central Government in the form of office accommodation, printing, and stationery, and expenses in connection with the International Commission on Large Dams, the Provinces entirely maintain the Central Board of Irrigation, whereas the Imperial Council of Agricultural Research and other similar bodies are financed by the Government of India, though the subjects dealt with are definitely provincial subjects, as is irrigation.

(*v*) Continuity of research, and therefore stability of income, are essential, and they should not be dependent on contributions and subscriptions from the Provinces. To ensure such continuity and stability to a central research institute, adequate permanent maintenance by the Government of India is essential. The resources dependent upon contributions from the Provinces, States and other bodies are liable to fluctuate, and under provincial autonomy, impossible to assess.

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3. The Central Research Station should be situated as near Delhi as possible, and Chajunagar on the Agra Canal is suggested as a possible site.

4. In order to secure continuity of the work now in hand the Government of India should continue to finance the Hydrodynamic Research Station at Khadakvasla for hydrodynamic work, until such time as the new Station is ready.

The following new subjects were accepted for investigation during the ensuing year :—

The Fertility of Silt.

The Effect of Deforestation on Irrigation Projects.

The following office-bearers were elected for the ensuing year :—

Mr. M. R. Richardson, C.I.E., Chief Engineer, U. P., *President.*

Mr. A. Gordon, C.I.E., Chief Engineer, Sind, *Vice-President.*

Mr. J. D. H. Bedford, Chief Engineer, Punjab, *Third Member of the Executive Committee.*

The following changes in the Membership of the Board have taken place during the quarter :—

Sir William Stampe, Kt., C.I.E., Chief Engineer, United Provinces, retired from 1st November 1937. As the post which he held has been abolished, there will now be only two U. P. Members instead of three.

Mr. C. C. Mackintosh, Chief Engineer, Burma, returned from leave at the beginning of November and took over from Mr. A. A. H. Ricketts.

Mr. H. A. Hyde, C.I.E., M.C., Chief Engineer, C. P., proceeded on leave preparatory to retirement with effect from 16th November 1937 and Mr. P. V. Chance has succeeded him.

Research Committee.

Dr. N. K. Bose, Mathematical Officer, Punjab Irrigation Research Institute, Lahore, is officiating as Director of the Institute during the absence on leave of Dr. E. McKenzie-Taylor.

Board Publications.

1. Revised edition of the "Glossary" (Publication No. 5) is still under preparation as replies from some officers are still awaited.

2. Mr. C. C. Inglis has written a note entitled "Instructions for Designing Standard Standing Wave Flumes", and if it is accepted by the Board it will be issued as a Board Publication.

3. Board Publication No. 12 entitled "Design of Weirs on Permeable Foundations" by Rai Bahadur A. N. Khosla, Dr. N. K. Bose and Dr. E. McKenzie-Taylor is now undergoing final printing, and copies will be distributed to Provinces early in the new year. In addition to providing a complete guide to the design of works on permeable foundations, this publication contains very useful information regarding the maintenance of those works, and the design of retaining walls, etc.

4. The questionnaires on "Conditions Predisposing to Harmful Soil Stauration which may Ultimately Result in Waterlogging "and "Land Reclamation" are to be printed up in the form of Notes, and distributed to Provinces.

5. At the last annual meeting the Board decided not to accept Mr. P. Claxton's Note on "Silt Load on the Behaviour of Rivers" as a Board Publication.

6. The Board accepted the recommendation of the Research Committee that the U. P. Government should be sked to place Mr. Gerald Lacey on special duty to write a publication on the Design of Channels in Alluvium.

7. The question of publishing Mr. C. C. Inglis's report on his experiments with the design of canal falls as a Board Publication was referred to the Research Committee.

Works Section.

UNITED PROVINCES.

Chitaura Power House.

This Power House is a duplication of the Salawa Power House (notes about which have been published in Bulletin No. 5), *i. e.*, it is designed to give a continuous output of 3,000 k. w. by means of two turbo-alternators operating on a head of 15 ft. It is also sited on a by-pass from the Ganges Canal.

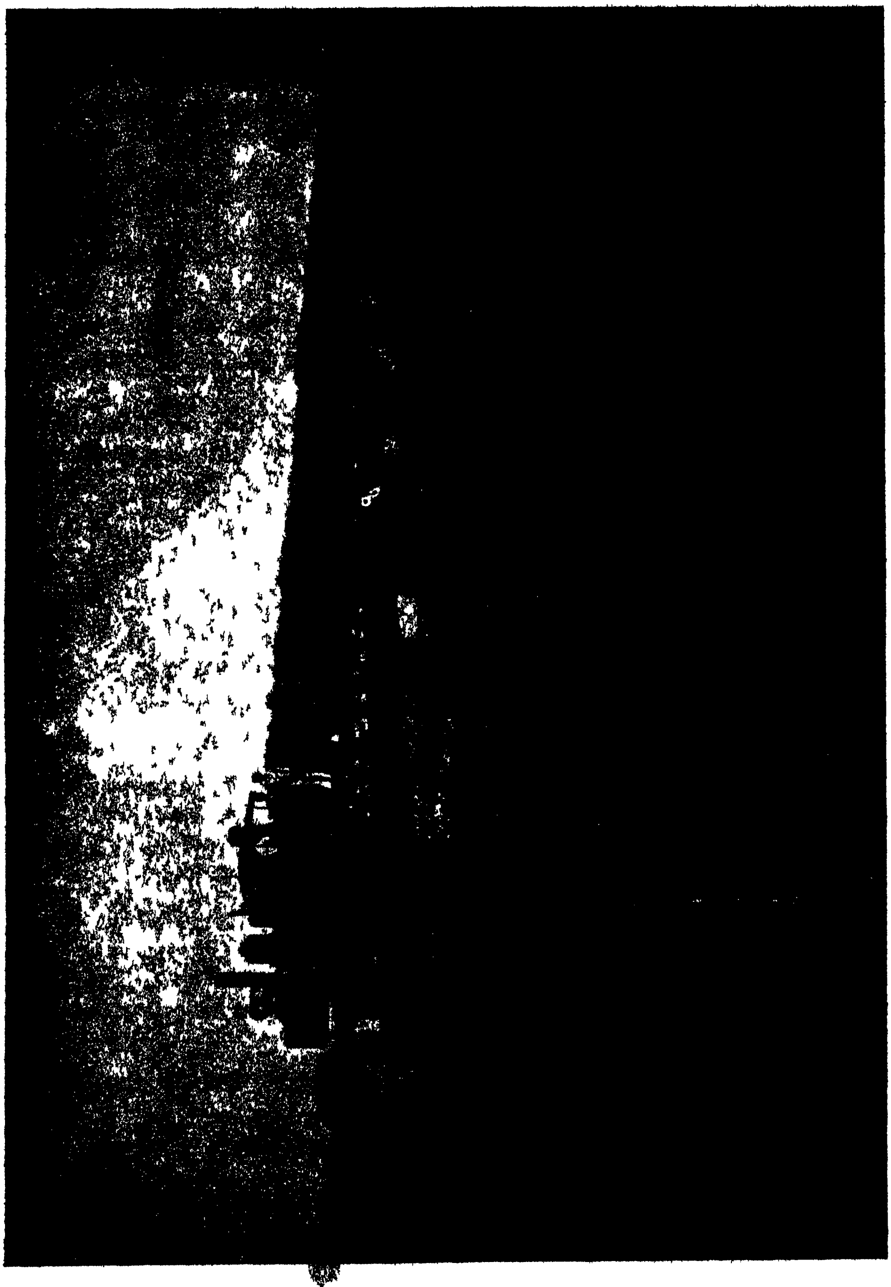
The total cost of the Power Station is approximately Rs. 15 lakhs. Unlike Salawa, where the foundations were particularly bad and consisted of running sands, Chitaura is founded on a reinforced concrete open Slab. A few masonary wells only were sunk at the points where the main loads of the machines were concentrated.

Work was commenced in September 1935 and the Station was put into commission in April 1937.

Nirgajni Power House.

This Power House of 4,000 k. w. capacity is estimated to cost, with subsidiary works, Rs. 7,97,508 (for civil works only). A water supply of 4,000 cusecs is available with a head of 15 ft. The general layout and design is similar to the Salawa and Chitaura Power Houses, with the exception that Nirgajni Power House is founded on Franki piles (as against masonry wells in the other power houses). These piles have proved eminently suitable as foundations.

Very little trouble in laying the foundations was experienced due to the total excavation being in good clay which goes down some 6′ below spring level.



Franki pile driving was commenced early in November 1936. The power house, ready for machinery erection, was handed over to the North Hydel

Division on the 7th April 1937. The Station is expected to be finished in all respects in February 1938.

Daurala Sugercane Tramway project.

This Tramway Project was conceived early in 1934, with the object of providing transportation facilities for sugarcane grown in the irrigated tracts of the Anupshahr Branch of the Ganges Canal. Lack of communications in the past had prevented the sale of sugarcane to the factories.

There are six factories situated on the North Western Railway between Begamabad and Muzaffargarh to which supplies can be made from the Tramway.

The Tramway alignment is from Daurala, east to Dhakauli, a distance of 14½ miles, thence one branch running north for 5 miles to Kaul, and a second branch running south for 8½ miles to Parichhatgarh.

A gauge of 2 ft. wide adopted. For the track 41¼ ℔ flat-bottomed steel rails spiked to sal wood sleepers were used. Some 35 ℔ and 30 ℔ rails were also used. The ruling gradient is 1 in 330.

Bridges are of steel girders with masonry foundations, the sleepers being seated directly on the girders. The Kali Nadi Bridge (shown in the photograph on the opposite page) provides 3 spans of 30′ and two end spans of 16′ ; abutments have open foundations but piers are founded on wells sunk to 28′ below the bed level. Main culverts are of reinforced concrete. Smaller ones are of Hume pipes with masonry parapets.

The present stock of locomotives consists of 5 Baldwin locomotives of 50 H. P. and one Oriensteen & Koppal of 20 H. P. The rolling stock consists of 80 five ton capacity open four-wheeled trucks and 70 three ton capacity open trucks.

The total cost of the Tramway is approximately Rs. 5½ lakhs.

" Usar "Reclamation on the Sarda Canal.

In conjunction with the Agricultural Department, plots of light usar are being reclaimed in the lower portions of the Sarda Canal. To date, approximately 400 acres have been taken up. The process consists of sowing sun hemp with canal water in May, and afterwards ploughing in and sowing a salt resisting rice. Water is given free to land owners for two years to encourage them to break up their light usar land, and the results to date appear promising.

Information Bureau and Library.

The following are some of the enquiries dealt with during the quarter :—

Rainfall and Run-off.
Silting of Reservoirs.
Navigability of Indian Rivers.
Sub-soil Drainage.
Siltometers.

Miscellaneous.

1. The Hydrodynamic Research Station at Khadakvasla (near Poona) is to be continued during the next financial year, provided the Secretary of State will agree to an extension for Mr. Inglis, the Director, who is due to retire in February 1938 All new experiments carried out for Provinces and other authorities will have to be paid for, and no work will be undertaken which cannot be completed during the year 1938-39.

2. A questionnaire on "Drainage systems in irrigated areas" has been prepared, and copies will shortly be sent to Provinces with a request for information regarding existing drainage systems.

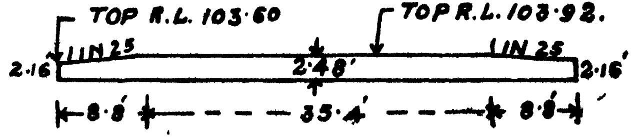
3. Sir Bernard Darley, Kt., C. I. E., formerly Chief Engineer in the United Provinces, and Bahawalpur State, has taken over the duties of honorary representative of the Central Board of Irrigation on the International Commission of Large Dams. The Central Board of Irrigation constitutes the National Committee for British India.

4. At the last Board meeting the question of selecting an officer to succeed the present Secretary of the Central Board of Irrigation in 1939 was referred to the Executive Committee of the Board, and a selection will be made early in 1938 to enable the selected officer to take long leave before taking over charge for a period of four years.

5. The design of a Fall of 5·2 ft. for 1630 cusecs, which was supplied by Mr. C. C. Inglis, was reproduced in the last Bulletin (facing page 15). Mr. Inglis has now improved the design of the baffle as follows :—

FRONT ELEVATION OF THE BAFFLE.

SCALE: 20′ = 1 INCH.



Mr. A. M. R. Montagu, Executive Engineer, Punjab, has also designed a fall for the same conditions and it is shown in the sketch on the opposite page.

6. Preliminary experiments are to be carried out in Bengal on the construction of asphalt revetments for river bank protection, similar to those in use in the U. S. A. (For further particulars see under "Other Publications" in the Literature Section of this Bulletin).

7. The following are some notes in connection with works in progress in the Punjab :—

(*a*) ***Haveli Project.***—Work on the Trimmu Headworks and the Main anal is in full swing.

Trimmu Headworks is being designed in the light of the latest hydraulic researches. Its design is in advance of anything that has been done in the Punjab so far. The entire section of the Weir and the undersluices is a reinforced concrete slab of 1 : 2 : 4 concrete designed to withstand the upward hydrostatic pressure due to a head of 29 feet in the undersluices and 25 feet in the case of the Weir. Between the piers the reinforced concrete slab is designed as a raft foundation on Baker's Soil Line theory. Thus the objections of layers of concrete separating from each other, so troublesome in old weirs, have been eliminated. A factor of safety of 5 has been allowed in the downstream exit gradient.

Another important point in the Weir design is that all the important structures, such as gates and bridges for the superstructure of gates and arterial road have been enclosed by two lines of sheet piles, placed at the upstream and downstream toes of the glacis. These sheet piles increase the bearing value of the soil enclosed by them and serve as important lines of second defence, in case the downstream floor is damaged in any bay.

A very up-to-date silt excluder is being combined with the undersluices to exclude all coarse silt from entering the Canal.

Every detail of the design has been tested in the Hydraulic experimental stations at Lahore and Malikpur.

The entire Main Line in a length of about 45 miles is being lined with two layers of reinforced brick tiles 12"×6"×2" enclosing a 3/8" layer of 1 : 3 cement mortar between them. The section of the canal is 80 feet bed width and 12 feet depth. As the co-efficient of rugosity is less in a lined channel, as compared to an unlined one, a smaller section is sufficient to pass the same discharge with the same slope. The result is that the lined channel of the main line will cost only 10 lakhs of rupees more than the project provision of an unlined channel.

All channels on the Haveli system are being designed with facey's f.=0·8. In a few cutting reaches, where there is appreciable slope in the country, the value of Lacey's f has been taken up to a maximum of 0·9. The silt excluder at the head will exclude all silt coarser than f.=0·8.

Special concession rates have been obtained for cement and reinforcement steel by careful negotiation.

(*b*) *Islam Weir.*—The work on driving a pile line downstream of Islam Weir is progressing satisfactorily.

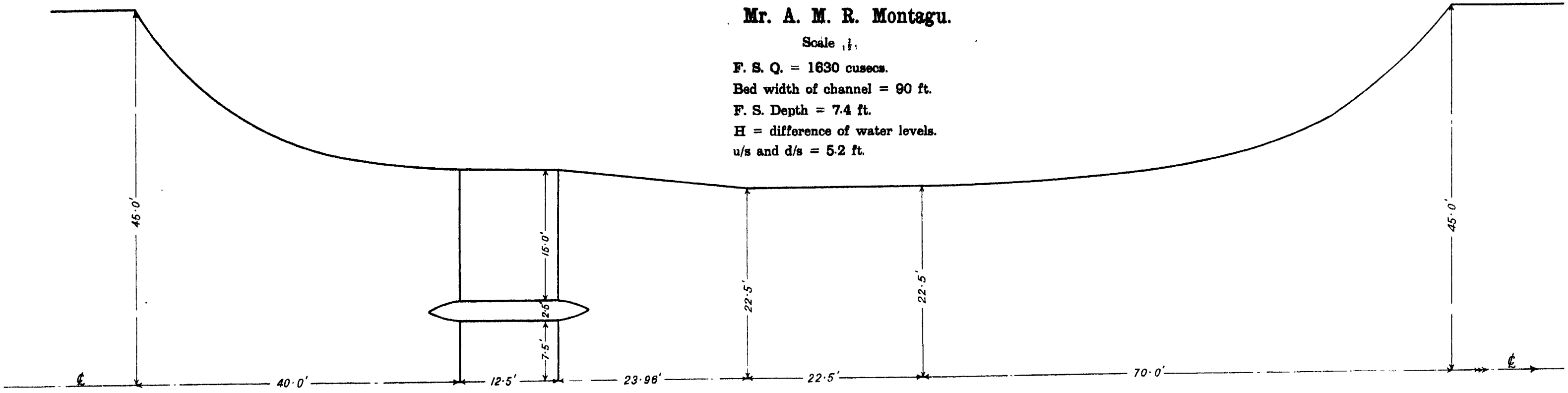
(*c*) *Western Jumna Canal.*—The undersluices of the Western Jumna Canal at the Tajewala Headworks consist of 20 feet bays with springing of acrches at R. L. 1070·5 against the Highest Flood Level of 1070. The undersluices are now being remodelled at a cost of Rs. 1,75,000 to provide a clear waterway up to the highest flood level, and proper gates are being put in. This will increase the capacity of the undersluices considerably and reduce the chances of the bays being fouled by trees in floods.

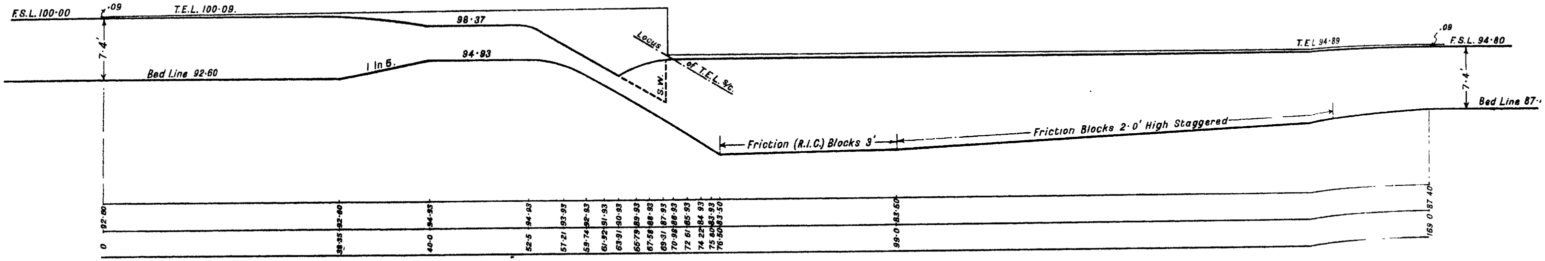
This is the first part of the scheme sanctioned for Rs. 5,74,000 in order to enable the Weir and undersluices to pass a maximum flood of 5 lacs of cusecs instead of the existing designed discharge of 3½ lacs.

HYDRAULIC DESIGN OF A FALL
supplied by
Mr. A. M. R. Montagu.

Scale $\frac{1}{12}$

F. S. Q. = 1630 cusecs.
Bed width of channel = 90 ft.
F. S. Depth = 7·4 ft.
H = difference of water levels.
u/s and d/s = 5·2 ft.





Army Section 6 D. O. S. of. I. No. 9050 Dec. 1937.

(*d*) ***Kashmir Canal.***—The Kashmir Canal of the Kashmir State is fed by heading up water by a boulder masonry bar across the Ravi river in the vicinity of Madhopur, called the Dhanna Weir, the central part of which was washed away in 1935 due to erosion downstream of the Weir and after this, retrogression of the bed of the river proceeded so rapidly that the command of the Kashmir Canal was seriously at stake. As no other site was found suitable for a new bar, the old Dhanna Weir is being repaired at a cost of about Rs 1,20,000 during this winter.

8. In 1936-37, as a result of concerted action of the Director of Agriculture, U. P., and Mr. M. R. Richardson, Chief Engineer, Irrigation Branch, U. P., the Government of the United Provinces sanctioned the opening of two demonstration centres on the Mat Branch of the Ganges Canal. At these centres the most suitable crop rotations for the water normally available to zemindars will be demonstrated.

9. The following are some of the investigations recently carried out or are still in progress in the United Provinces.

(1) Two investigations by models have recently been undertaken.

(*i*) In the case of the Bahadurabad Power House, Upper Ganges Canal, a model was constructed to determine (*a*) what conbination of discharges through various bays produces the maximum scour, and (*b*) which combinations are permissible if scour is to be minimized.

The model was constructed to a acale of 1/25 and sand from the Gomti river was used. Three series of experiments were conducted with discharges of 0·96, 1·60 and 2·24 cusecs in the model, representing 3000, 5000 and 7000 cusecs in the prototype. The results arrived at were that the minimum scour in each series of experiments took place when all the bays were running with equal discharges, while the worst scour occurred in the case of 3000 cusecs discharge when the third bay was running with 1500 cusecs, the 4th with 500 and the fifth with 1000 cusecs, all the other bays being closed. Conditions of worst scour in case of 5000 and 7000 cusecs discharge were also investigated and determined.

A few more experiments were carried out to see if the extension of piers affects the scour in any way. It was found that if all the seven piers are extended by 12″ in the model, representing 25′ in the prototype, the worst scour occurring in each series of experiment, was reduced by about 40%.

(*ii*) In the case of the Flumed Fall at M. 18-1-495 Mat Branch, a model was constructed to determine a device for the prevention of the severe scour which occurred below the fall.

The model was constructed in brickwork to a scale of 1/14. A number of experiments totalling sixty seven were carried out and different devices in the form of Montagu friction blocks, deflectors, rectangular and trapezoidal baffles were tried at different positions in the floor. A 21″ high baffle wall placed 43 ft. downstream of the crest gave the best results, reducing the scour by 85%. A sketch of this baffle design is available in the Board's office.

(2) The design of the model of the Absara syphon, Rohilkhand Canals Division is in hand, and experiments for designing a device to reduce the scour occurring below this work will shortly be taken in hand.

(3) In order to estimate the life of the Khurwai Reservoir the ratio of the mean annual runoff to the capacity of the reservoir with the rate of silting was plotted in the case of 14 dams in India and the United States. The results obtained are that when the above ratio exceeds 20 the rate of silting decreases with the decrease of the ratio in a regular manner, but when the ratio is below 5 there is no connection with this ratio and the rate of silting. A graph showing the plotting of these ratios is available in the Board's office.

(4) Observations of the water profile in connection with the calibration of the Karon Nadi flume on Hathras Branch have been analysed to ascertain the Etcheverry constants for the inlet and outlet transitions of a flumed section. They work out to 1·30 and 0·86 against 1·10 and 0·75 recorded by Prof. Etoheverry. Instructions for the preparation of standard designs for flumed sections will be issued later.

The following officers of the Irrigation Departments of the various Provinces received the honours noted against their names on New Year's Day :—

Alexander Gordon, Esqr., I. S. E., Chief Engineer and Secretary to the Government in the P. W. D., Sind	C. I. E.
Alfred Vipan, Esqr., I. S. E., Chief Engineer and Secretary to Government of Orissa, Public Works Department	C. I. E.
Diwan Bahadur Gopaldas Hassanand Keswani, I. S. E., Executive Engineer, Sind	M. B. E.
Babu Ramani Mohan Sinha, Executive Engineer, Bankura Division, Irrigation Branch, Communications and Works Department, Bengal Presidency	Rai Bahadur.
Mr. Mohammad Fakhar-ud-Din, Executive Engineer, P. W. D., Irrigation Branch, Punjab	Khan Bahadur
Mr. D. V. Joglekar, Bombay Service of Engineers, Asstt. Engineer (at present officiating Executive Engineer, Central Irrigation and Hydrodynamic Research Station, Poona), Bombay Presidency	Rao Sahib.
M. R. Ry. Kesava Rao Tombat, Avargal, officiating Executive Engineer, Madras Presidency	Rao Sahib.
Babu Subodh Chandra Ghosh, Overseer, Subordinate Engineering Service, P. W. D., Bihar	Rai Sahib.

LITERATURE.

The following literature was received during the quarter.

Readers are reminded that they are at liberty to borrow any of the literature in the Board's library, in accordance with the rules published in Bulletin No. 3 and to submit enquiries on any matter dealing with irrigation and allied subjects.

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CIVIL ENGINEERING AND PUBLIC WORKS REVIEW.

Vol. XXXII.

No. 375—September 1937.

Foreign Notes.

A Multiple Arch Dam.

A multiple arch dam at Beni-Bahdel, Algeria, built in reinforced concrete, in which the arches have an unusually large span is described in *Bull. Tech. Suisse Rom.* 63, 141. The total length of the dam is 1,056 ft., the central 726 ft. consisting of eleven arches while the wings are of gravity type. The counterforts are 66 ft. apart and are triangular. The arches are cylindrical with a diameter of 56¾ ft. The thickness of the arches varies from 4¼ ft. at the bottom to 2·3 ft. at the top and they spring from strongly reinforced concrete skewbacks resting on the inclined faces of the counterforts. Geological features of the site are described and a few other details of the work are given.

The Storstrom Bridge Completed. Engelund.

The main features of the design and construction of this bridge in Denmark are described. The total length of the bridge is about 2 miles and it consists of three navigation spans near the centre and forty-seven smaller spans. The navigation spans are of plate girder reinforced by polygonal arches. The smaller spans are all of plate girder construction.

The piers consist of hollow reinforced concrete shafts resting on a solid mass of concrete. The average depth of pier foundations is 23 ft. The contractors developed a special method of pier construction in open cofferdams, utilizing special movable steel cofferdams instead of the usual sheet piling dofferdams. This equipment and its operation are described in detail.

Stained Brickwork : Its Causes and Remedy.

In Technical Bulletin No. 3 entitled "Efflorescence and Staining on Brickwork" issued by the Clay Products Technical Bureau of Great Britain, the exact causes of and the possible remedy for the white staining or efflorescence which occurs on brickwork, are fully outlined.

The salts most frequently causing this disfigurement are the sulphates of magnesium, sodium and calcium. The sources of these may be either external or internal. The external source is the soil which contains a greater or lesser amount of the salts dissolved in the soil moisture. In the absence of a damp-proof course the soil moisture is drawn up by capillary action to the surface of the brickwork and on evaporation the salts are left on the surface as a white incrustation. The internal sources are the mortar or brick. Rich and dense mortars containing a high proportion of Portland cement or hydraulic lime or salt polluted aggregates are a frequent source. Precautions to be taken to eliminate efflorescence include

(1) Use of hard fired bricks in which there is no possibility of formation of the harmful salts.

(2) Introduction of damp-proof courses in all walls.

(3) Use of a correct mortar.

THE FERNILEE RESERVOIR.

The new waterworks for Stockport Corporation includes a reservoir in the valley of the river Goyt which is a tributary of the Mersey. The dam forming the reservoir is of the earthen fill type with a puddle core. A mass concrete cut-off wall is continued into the rock below the puddle core. It is 650 ft. in length, 132 ft. high and 680 ft. thick at the base. The puddle core is 30 ft. thick at the base and 6 ft. at the top. The concrete cut-off wall is 6 ft. thick carried into the rock to a depth varying from 50 ft. to 232 ft. It is built of 5 : 1 mass concrete, and is 950 ft. long. To prevent infiltration below and beyond the cut-off, extensive grouting has been employed, the total number of holes being 61 with a length of 12,000 ft. The dam has a roadway on the top 19 ft. 6 inches wide.

IMPOUNDING THE RIVER DERWENT: GOOD PROGRESS ON THE LADYBOWER RESERVOIR.

The Derwent Valley Water Board is constructing a reservoir known as the Ladybower Reservoir for the water supply of Nottingham and Sheffield. The dam forming the reservoir is an earthfill structure 1,250 ft. long and 141 ft. high with a puddle core and concrete cut-off wall in the rock below. The upstream slope has a batter of 1 : 3 and is stone pitched. The downstream face has a slope varying from 1 : 1½ to 1 : 2½. The free board is 10 ft. in view of considerable wave action which might be expected. Two bellmouth overflow weirs are provided to dispose of flood-water. A number of model experiments were carried out at Manchester University to arrive at the final design of these overflow weirs. In the design finally adopted the interior of the bellmouth is stepped instead of smooth, and radial cut waters are provided on the lip of the bellmouth to prevent vortex formation.

BUILDING SCIENCE ABSTRACTS.

EFFECT OF TEMPERATURE ON THE STRESS-DEFORMATION OF CONCRETE.

In a study of concrete creep, investigation has been made of the effect of temperatures ranging from 26°F. to 123°F. on the elastic and plastic deformation of Portland Cement Concrete specimens subjected to a sustained compressive stress of about 20 per cent. of their ultimate strength. These investigations and the conclusions arrived at are described.

VACUUM CONCRETE.

A description of the vacuum concrete process in which the water content is reduced by about 40 per cent. under a pressure of about 1/3 atmospheric pressure is given. This process obviates the necessity for heavy shuttering, and permits early removal of shuttering. Tests on vacuum treated concrete show that it is 30 to 100 per cent. stronger than ordinary concrete at the same age and that a 25 per cent. economy in cement is possible.

No. 376—October 1937.

FOREIGN NOTES.

SLAB BRIDGES.

Where headroom is limited, the simple slab type of bridge deck has many advantages for short and moderate spans. In *Beton und Eisen* 36, 209, W. Preisser describes the construction of several of these bridges with spans up to 104 ft. Where there is only a single opening the two-hinged portal form of construction is usually adopted, the abutment walls being made monolithic with the deck and hinged at the foundations. The bridge over the Lippe at Hanover has a span of 104 ft. The deck slab is 23·2 ft. wide, 3·45 ft. deep at the centre and increasing to 6·1 ft. at the abutments. The abutments are 6·1 ft. thick and the hinges are 20·5 ft. below road level, sunk into depressions in the foundation blocks.

BRIDGE BUILDING IN INDIA.

This article describes the Patalganga Bridge in the Bombay Presidency over a tidal creek where the water level ranges from 87·9 ft. at low water to 97·1 at high tide. The bridge consists of three reinforced concrete bow-string spans in the main stream with three continuous beam approach spans at either end. The bow-string spans are 100 ft. each and the approach spans are 48 ft. each giving a total length between abutments of 584 ft. 6 in. Foundations in open excavation were adopted for the abutment and two shore piers at the south end. The foundations of the four piers supporting the bow-string spans were constructed by sinking thin reinforced concrete cylinders. Two cylinders 11 ft. 10 in. outside diameter were provided under each pier and they were cast on artificial islands constructed in the stream at the pier sites. They were sunk by ordinary hand excavation in the open, and when solid rock was reached they were filled with 1 : 2 : 4 plum cement concrete. Reinforced concrete caps were provided over the cylinders to carry the piers. The foundations under the shore piers and abutment at the north end consist of masonry wells, two on each foundation built of rubble masonry in 1 : 4 cement mortar and plastered on the outside with the same mortar. A feature of the construction of these wells is the sealing of the bottom. As the concrete had to be placed in water, it was carried out by colloidal grouting. This consists of depositing large aggregate for the concrete in position and subsequently grouting this by injecting a colloidal cement. The method was entirely successful and produced sound watertight concrete. The piers were built of rubble masonry in 1 : 6 cement mortar and the abutments are of reinforced concrete box construction. The bow-string spans are of a special type, the hangers which carry the roadway being inclined and not vertical as is usually the case. This type of hanger eliminates all moments in the arch rib and results in a lighter and more economic construction. The spans are carried on cast-steel rocker and roller bearings.

NEW MASONRY DAM FOR TORQUAY CORPORATION.

The Torguay Corporation is constructing a new reservoir to augment its existing water supply. This article describes the dam forming the reservoir and other appurtenant works. The dam has been designed as a masonry structure of the gravity type straight in plan with a battered upstream face and a stepped downstream face. The overflow section of the dam is 150 ft. in length with a downstream slope of 1 : 1·55 finished off at the top with a parabolic curve connecting the face to the horizontal crest. The body of the dam will consist of rubble masonry consisting of granite "plums" in 1 : 2½ : 5 Portland cement concrete while the facing upstream and downstream will consist of squared blocks of granite with joints extending inwards from the face not less than 18 inches. The masonry on the upstream face will be built in aluminous cement to counteract the corrosive action of the moorland waters. Contraction joints will be provided at intervals of 50 ft. at right angles to the centre line of the dam. Sheet copper water stops filled on the upstream side with bitumen will be incorporated in the joints. In order to minimise the heat of hydration and reduce the tendency for the development of cracks in the concrete, a special coarse, low lime content Portland cement is being manufactured. An analysis of the cement is given. Other works described are the outlet tunnel, valveshaft, draw offs, river diversion works, and inspection galleries in the body of the main dam. The dam will be founded on rock and the depth of excavation has reached 40 ft. below the ground surface.

LOW LEVEL BRIDGES: THEIR ADVANTAGES FOR TROPICAL CONDITIONS.

McConnel.

Low level bridges which are liable to be submerged during the rainy season and in floods are discussed in this article. The general principles of design and siting of this type of bridge are described. The lateral forces to which such a bridge is subject and which must be taken account of in design are enumerated and the factors governing the location of this type of bridge are mentioned. The most important feature to be considered in design is the determination of the size of the spans so that they are not liable to be choked with flood debris. These bridges are usually of reinforced concrete construction though timber bridges have also been adopted largely in Australia.

BURNHOPE RESERVOIR OPENED.

See under "Water and Water Engineering", October 1937 of this Bulletin.

THE MOSCOW VOLGA CANAL.

This is a navigation canal which has recently been opened to traffic in U. S. S. R. The important features of this scheme are described. The canal is 79·5 miles long of which 12·5 miles are across reservoirs and impounded lakes. The deepest cutting for the canal is 75·5 ft. and the highest embankment is 46 ft. The dimensions of the canal are :—

Width at water level 280 ft.

Width at bottom 151 ft.

Depth of water in channel 18 ft.

There are eight sets of locks on the canal built in reinforced concrete and fitted with electrically operated gates. Five pumping stations on the canal lift water for Moscow municipal waterworks. A number of hydro-electric stations have been built at several points for generation of power. Of the dams on the canal, three are of reinforced concrete and eight are earthfill. The most outstanding structure is the Volga Dam in reinforced concrete which is 708·5 ft. long and 85 ft. high. On account of the severe climatic conditions occurring in Russia, the concrete in hydraulic works has been protected by a coating of bitumen to withstand action of frost. The construction equipment is mentioned and brief details of important construction procedure are given.

BUILDING SCIENCE ABSTRACTS.

CONCRETE: ITS MAINTENANCE AND REPAIR.

Am. Conc. Inst. J., 1937, 8. Directions for repairs to concrete roads are given herein. Waterproofing of road surfaces by painting with oil paints, waterproof varnishes and bituminous dressings is discussed. Methods of stopping passage of water through construction joints are described, and directions for the patching of concrete are given.

THE THEORY OF SOIL CONSOLIDATION AND TESTING OF FOUNDATION SOILS.

Pub. Roads 1937, 18 (1). In this report several devices constructed at the U. S. Bureau of Public Roads and used for soil testing are described. The theory of consolidation of earth materials is discussed and mathematical derivations used both for the computation of earth pressures and stresses and for the computation of formulæ applicable to the consolidation of relatively impervious saturated strata caused by these pressures are introduced. One of the most useful tools in the study of soil consolidation is the laboratory compression device designed by Terzaghi. A brief description of the essential features of this device is given and typical permeability, compression and consolidation curves are presented for an undisturbed sample of compressible soil.

No. 377—November 1937.

EDITORIAL.

STEAM *versus* WATER-POWER.

Comments on the Presidential address of Mr. S. B. Donkin delivered before the Institution of Civil Engineers. A portion of the address in which he deals with the comparative values of generation of electricity by steam and water power has been quoted to show the future possibilities of water power schemes, specially if the prices of fuel continue to rise.

FOREIGN NOTES.

Dixon.

MODEL STUDIES FOR TIDAL ESTUARIES.

In *V. D. I. Zeitschrift 81*, Prof. Seifert discusses the results which have been obtained at the Prussian State Laboratory, Berlin, from the study of models of tidal estuaries. A model of a length of 72 miles at the mouth of the river Eider was studied in order to see the effect of providing embankments for land drainage. It was found that the restriction of the channel caused a slight rise in the high water levels and a considerably greater fall in the low water levels. This result was found satisfactory as a fall in low water levels would improve drainage. The embankments were therefore constructed. Actual observations of high and low water levels after the construction of the embankments showed that the results were in close agreement with those obtained from the models. Another investigation was in connection with the prevention of silting in the harbour of a petroleum refinery on the Lower Seine. The model reproduced the estuary for a length of 3·6 miles and was built of concrete, powdered amber being used to reproduce the silt. Tidal conditions were reproduced by two tidal generators. It was observed that a large vortex formed within the harbour on the falling tide from which silt was deposited. This vortex formation was prevented by two groynes at the harbour entrance, their action being studied in the model. A more difficult problem now being studied is the reclamation of slob lands on the west coast of Germany. The method of reclamation selected depends on theco nstruction of banks to form new watersheds and thus to influence the drainage of the slob lands.

AUTOMATIC SYPHON SPILLWAYS.

The application of model studies to the design of syphon spillways is considered by M. Hegly in *Annales des Ponts et Chaussees, 107, 733.* Investigations with models were carried out for the design of new spillways for some reservoits near Nancy. Experiments were made with three helical syphons of one tenth full size, and one full size syphon. The models were in solid drawn steel and had bell mouthed intakes. Coefficients of discharge for the syphons were determined. The author concludes that experiments with models of syphons on scales of one fifth to one twentieth full size give satisfactory results.

THE KILOSA BRIDGE. Stevenson.

This is a bridge constructed in Tanganyika territory and consists of one main span 120 ft. clear and five approach spans 34 ft. clear. The main span is of lattice girder type. The decking is of reinforced concrete. The piers and abutments are of mass concrete. The foundations of one abutment and one pier are of open mass concrete construction. The other abutment is founded on a reinforced concrete raft and four remaining piers are founded on reinforced concrete caissons. Construction operations are described in this article. Difficulties in the foundation work where running sand and water were encountered are described and the manner in which they were overcome are mentioned.

THE SETTLEMENT OF FOUNDATIONS ON CLAY. Allin.

Clay and cohesive materials of similar characteristics have been partly or completely responsible for the majority of important failures of foundations and earthworks of which records exist. This is because in cohesive soils the settlement under load continues for years and is therefore difficult to determine. During the last decade research on the physical properties of clay in relation to its rate and amount of settlement under load has developed with important results. Dr. Terzaghi's work in this field is mentioned and the apparatus developed by him for testing compressibility of soil samples is described. From laboratory tests on compression, expansion, permeability, etc., of samples it is possible to make approximate predictions of the rate at which settlements would occur in foundations on clay and other soft materials, and their ultimate value. During the earlier stages of this research clay samples were tested in a remoulded condition because of the difficulty of extracting them undisturbed from the drill hole. Later experiments with undisturbed samples indicated that undisturbed clay has greater strength and elasticity than that which has been remoulded. Assumptions and approximations which must be made in predicting settlement of structures from compressibility tests in the laboratory are discussed and conclusions drawn from the research on physical properties of clay soils are given.

CORROSION-RESISTING STEEL IN CIVIL ENGINEERING.

During recent years a number of low and medium carbon steels with small admixtures of alloying elements such as nickel, copper, chromium, etc., have been developed which are claimed to be highly resistant to corrosion. These are available in a wide variety of forms including plates, sheet and strip, sections and bars, tubes, castings and pressings. They are readily welded by the electric arc process. A number of applications of these products are described in this article. A very large tonnage of this kind of steel has been employed in the heightening of the Assouan Dam. Other uses mentioned are the lining of a length of the river Derwent used as the measuring channel, to prevent moss and vegetable growth, and the use of bars of this material for reinforced concrete in modern buildings. This steel was extensively used in the reconstruction of the St. Paul's Cathedral, London.

BUILDING SCIENCE ABSTRACTS.

A STUDY OF SUB-AQUEOUS CONCRETE.

American Concrete Institute Journal, 1937, 8. Certain studies are described to determine the comparative strengths of concrete placed in water and in air and to determine the most advantageous mix for concrete to be placed under water. Some of the conclusions are : (1) Strength of concrete placed under water is lower than that placed in air for identical mixes ; (2) mixes which would be over sanded for concrete placed in air gave relatively strong concrete placed under water ; (3) a very finely ground cement yielded higher strengths than ordinary Portland cement for concrete placed in water.

THE PREDETERMINATION OF THE TEMPERATURE RISE IN LARGE MASSES OF POURED CONCRETE.

Zement, 1937, 26. Heat losses into the atmosphere during concreting in mass concrete structures are discussed. A solution is given

in integral form for the difference between the temperature of the concrete and that of the air as a function of position and time. The equation makes allowance for the fact that as the rate of concreting is increased the heat losses into the atmosphere will diminish.

This issue contains a Public Works, Roads and Transport Exhibition Supplement, in which are given the exhibits of various firms at the London Exhibition held on November 15-20, 1937.

CONCRETE AND CONSTRUCTIONAL ENGINEERING.

VOL. XXXII.

No. 9—September 1937.

EDITORIAL NOTES.

THE PLASTIC THEORY.

The editor briefly reviews the development of various theories for reinforced concrete design leading up to the present standard method incorporating the modular ratio. In recent years a new theory of reinforced concrete design rejecting the modular ratio as a factor in design has been advanced. An account of some theories of this type with a detailed description of that due to Prof. Saliger have been published in this journal and discussions on this theory are being published. The editor discusses the various objections to the standard modular theory and the methods proposed to amend the theory. He then reviews the new theory and discusses the points in favour of and against it. In the end he concludes with the remark that it is yet unproved that the new theory provides a sounder basis of design than the standard modular theory.

THE MODULAR RATIO : A NEW METHOD OF DESIGN OMITTING m.

Further comments by several writers on this paper by Dr. Hajnal-Konyi in which he puts forward a new theory of reinforced concrete design, are given. Dr. Hajnal-Kony's reply to the discussion is also given.

DESIGN OF DOMES.—II. Terrington.

This article is continued from the previous issue and gives a method of designing thin spherical domes of varying thickness in reinforced concrete. An example is worked out to illustrate the method, and a graphical method of design is also given.

No. 10—October 1937.

Experiments with Cold-worked Steel as Reinforcement.

Evans.

In this paper the results are discussed of an investigation concerning the deflection and steel strain in concrete beams reinforced with either cold-worked (overstrained) steel or carbon steel of approximately the same yield strength. An appreciable increase in the yield stress of cold-worked or over-strained steel together with the adoption of higher working stresses in the reinforcement has resulted in increasing use of cold-worked steel in reinforced concrete. Tests were made with rectangular and T beams, the spans being 100 inches and 60 inches respectively. The cold-worked steel consisted of pairs of mild steel bars twisted together helically and rigidly restrained against longitudinal movement, thereby stretching the bars during the twisting operation. Particulars of the beams and reinforcements are given and the results of tests are presented graphically.

The results show that for equal stresses in the tension reinforcement the deflection and steel strains in concrete beams reinforced with cold-worked or overstrained twisted steel rods are greater than those in beams reinforced with high-tensile or carbon steel rods of the same diameter, the beams being identical except for the grade of reinforcement used.

Tidal Sluices on the River Medway.

(*See* page 30 of Bulletin No. 7).

Design of Domes.

Terrington.

Continued from the previous issue. A graphical method of checking the designs worked out as examples in previous issues is given. Other problems dealt with are the design of flat domed roofs and conical domes.

Concreting under Water at the Storstrom Bridge in Denmark.

The foundation of this bridge consists of 51 piers resting on the sea bottom. A special form of cofferdam was used for the construction of the piers but investigation of the soil at the bridge showed that for a certain number of piers it would be risky to pump out the water until the bottom had been sealed with concrete. It was therefore decided to deposit the concrete in the foundation slab of these piers under water by a special method. In this method the area to be covered is divided into sections of a suitable size so that each section can be deposited in a few hours in such a manner that the cement is not pressed out from the newly placed concrete. The division was made with shutters placed by divers who carefully tightened the joints. When the shuttering was ready a 10 inch vertical steel pipe was placed with its lower end on the bottom of the first compartment. The pipe was supported from a platform which also carried the hopper for the concrete and winches for lifting or lowering the pipe. When concrete placing started, the end of the pipe rested on the bottom. It was then filled with concrete and subsequently lifted just sufficiently to allow the concrete to flow out. Simultaneously additional concrete from the hopper was poured in the pipe so that it was always full. The concrete was thus poured from the bottom, the first batches forming a protective surface which was raised as concreting proceeded and effectively protected the concrete underneath from the effects of the water. Twenty three foundation slabs were carried out in this manner with invariably good results.

THE MODULAR RATIO.

Comment on the above article by Prof. Magnel.

No. 11—November 1937.

PILING AT THE KENT CEMENT WORKS.

Taylor.
Buxton.

The Kent works of the Associated Cement Manufacturers Ltd. is built on a site consisting of marshland, and all the important buildings and machinery are carried on piles of reinforced concrete and timber. Recently the works were extended and the piles used for the extension were 16 inch square reinforced concrete pre-cast piles 50 ft. long, 147 in number. Some of the piles came to a satisfactory set with their heads above ground level while some had to be driven several feet below ground level, which necessitated the use of a hardwood dolly for driving below ground. The ultimate resistance of piles is usually estimated from Hiley's formula, but for the piles driven with the dolly this formula was found to be unsuitable and a method of assessing the bearing capacity was developed. This method is explained in some detail. Other information regarding the piling operations including results of a test on a driven pile are also given.

FLOW IN CHANNELS.

Hogan.
Gibbs.

The authors in a series of articles entitled " Uniform Flow in Pipes " published in this journal sometime ago, discussed flow in pipes (*See* page 20 of Bulletin No. 4 and page 18 of Bulletin No. 5). In the present series of articles, of which this is the first, they discuss flow in open channels. The two cases of flow in pipes and open channels are not so vastly different as they appear at first sight. In a pipe running partly full the slope of water surface controls the quantity discharged as in the case of an open channel. Flow in a channel is said to be uniform when the depth and velocity of a stream, the cross section and the slope of the bed of the channel remain constant. In a river or natural water course, the conditions for uniform flow are seldom fulfilled. In the case of pipes two types of flow have been discussed namely viscous flow and turbulent flow. These can also exist in channels but viscous flow is rare. Turbulent flow can occur in either of the two forms known as tranquil or streaming flow, and rapid or shooting flow. For any particular rate of flow in a channel, there is a depth corresponding to which the total energy of flow is a minimum, known as the critical depth, which marks the transition from tranquil to shooting flow. When the depth is less than the critical depth the flow will be shooting and when more, the flow will be tranquil. The authors then proceed to explain the total energy curve of flow and the equation of the energy curve is derived from first principles. From this equation by differentiation, an expression for the critical depth has been obtained which represents the depth corresponding to minimum total energy.

The effect of a change in the level of the bed is then studied with the help of the total energy curve. The effect produced on the surface of a stream by a submerged obstacle is also studied. The energy equation can be applied to channels of non-rectangular cross sections , and this has been illustrated by deriving an energy equation for triangular channels from the general equation.

The authors then discuss the distribution of velocity in open channels. It is essentially different from that in a pipe. In open channels the distribution of velocity on vertical sections is assymetrical and a double spiral type of motion is set up in the stream in consequence. These spiral motions have been observed by Gibson in the Mersey and in experimental channels. The effect of the spiral motion is to cause the maximum velocity to occur not at the surface but at a short distance below it. The distribution of velocity along a vertical situated at a sufficient distance from the sides for the flow to be unaffected by the friction at the sides, can be investigated by the aid of Prandtl's theory of fully developed turbulence. An expression has been obtained for the velocity at any point along the vertical. Velocities actually observed by a current meter along a vertical at one of the gauging stations of the River Severn are shown to agree very well with the velocities obtained from the equation.

ACTION OF SULPHATE SALTS ON CONCRETE.

Abstracts from a paper read at a meeting of the Institution of Sanitary Engineers by Dr. F. M. Lea. (*See* Quarterly Bulletin No. 5, page 41).

THE ENGINEER.

VOL. CLXIV.

No. 4262—September 17, 1937.

MISCELLANEA.

HYDRO-ELECTRIC POWER SCHEMES IN INDIA.

The Mysore Government has approved two hydro-electric development schemes. The first is at Shimsha falls and includes a 20 mile long power channel from the balancing tank at Sivasamudram to the site of the station at Shimsha falls. The second is at Jog falls and includes a storage reservoir of 7,200 m. cft. capacity.

THE BRITISH ASSOCIATION.

Dr. Oscar Faber presented a paper on air-conditioning in which he discusses the details of the problems and illustrates the essentials of a modern air-conditioning plant. The paper is directed principally to the problem of producing agreeable air conditions in offices, theatres, assembly halls and other such places, in which the requirements are adjustment of temperature and humidity, and filtration. He discusses the use of ammonia and carbon-dioxide for the refrigerating plant and points out the advantages and disadvantages of both. A modern development is the use of water and water vapour as the refrigerating medium. He gives some particulars of air filters in existing air-conditioning plants and gives the values of temperature and humidity associated with conditions of comfort in office buildings.

No. 4263—September 24, 1937.

STRAIN AND STRESS DISTRIBUTION IN DOUBLY REINFORCED CONCRETE BEAMS.

Evans.

In this article the results of tests carried out on doubly reinforced concrete beams are discussed. The beams were loaded at the middle third points and readings were taken at zero load and at a number of increasing and decreasing loads in each cycle of loading. The strain measurements were taken by means of a mirror extensometer. The tests were made with beams of different concrete mix.

No. 4264—October 1, 1937.

Nothing of interest to irrigation engineers in this issue.

No. 4265—October 8, 1937.

FEN DRAINAGE PROPOSALS.

At a meeting of the Great Ouse Catchment Board certain proposals were considered which are planned to prevent a recurrence of the serious flooding of the Fens which took place last spring. The schemes propoesd provide for the reconstruction and strengthening of the principal river banks, increasing the capacity of certain rivers by widening and setting back of floodbanks, and strengthening of certain floodbanks by breasting with clay. Much of the above work is well in hand.

AMERICAN HIGHWAYS AND HIGHWAY PRACTICE. Tratman.

This is the first of a series of articles dealing with highway practice in the U. S. A. An outline of the history of American highways is given. At the present time, there are more than 3,000,000 miles of roads comprising trunk roads, secondary roads, rural roads, and connecting links. The Bureau of Public Roads administers the Federal-Aid Road Programme in co-operation with the highway departments of the several States. The Bureau does no construction but carries on an extensive programme of research work in the field and laboratory. Modern trends in road design are described, and typical examples of road sections are given. Several types of roads as used in some of the States are described. Standard designs as adopted by some of the important States are also described.

No. 4266—October 15, 1937.

AMERICAN HIGHWAYS AND HIGHWAY PRACTICE. Tratman.

Continued from previous issue. Express highways are dealt with in this article. A recent development in roads of the express highway type is the " freeway " which is a highway to which the owners of abutting property have no right of access and no easement of light, air, or service. The road is completely fenced except at points chosen for connection with other roads by the highway authority. Some types of super-highways are illustrated and described, and their special features are mentioned.

MISCELLANEA.

A HYDRO-ELECTRIC SCHEME IN KOREA.

Work has begun on a large hydro-electric scheme in Korea which involves the harnessing of the river Kyosenko and the construction of 5 power stations with an aggregate output of 353,000 kW.

THE VOLGA HYDRO-ELECTRIC SCHEME.

Preliminary work has begun on the Kuibyshev hydro-electric development scheme which is part of the general plan of building on the river Volga a system of dams and hydro-electric stations. A dam to raise the level of the river some 30 m. is to be built above the city of Kuibyshev and two power plants are to be built with a total output of 2¼ million kilowatts.

No. 4267—October 22, 1937.

AMERICAN HIGHWAYS AND HIGHWAY PRACTICE. Tratman.

Continued from previous issue. Highway curves and gradients as adopted in American highways are discussed in this article. Designs of intersections of highways are also dealt with.

No. 4268—October 29 1937.

AMERICAN HIGHWAYS AND HIGHWAY PRACTICE. Tratman.

Continued from previous issue. The design of road crossings is further discussed. Arterial and terminal roads and their requirements are described, and some existing examples are cited. The various classes of roads comprising a highway system of the present day are briefly described and their necessary features are mentioned. The various constructional types and methods included in the total mileage of highways in the United States are discussed.

No. 4269—November 5, 1937.

EDITORIAL.

THE ENGINEER IN THE TROPICS.

The editor calls attention to the need of further scientific research in respect of the laws which govern natural phenomena in tropical regions. The hydraulic engineer has a vast field of research and practical work in tropical regions which are afflicted either with excessive rainfall and floods or by very little rainfall with its inevitable consequence of arid land. Much has been done recently by hydraulic engineers in India, Egypt, China, etc., in the field of water conservation, flood prevention, and water power utilization, but much more remains to be done.

FLOOD CONTROL AND STREAM FLOW REGULATION. Williams.

This is an abstract from a paper presented before the Institution of Sanitary Engineer and deals with some aspects of the question of river control. Certain suggestions are made for works on the Thames and Severn catchments, which illustrate the nature of the problems involved. After describing the physical characteristics of the Thames and Severn catchments, and the rainfall, the author passes on to the question of flood control. He discusses the effects of flood control by embankments on the river bed and on flood levels. Factors to be carefully considered in flood control by storage reservoirs include, proper siting, capacities of reservoirs, and the question of their economic feasibility. He considers it doubtful if large reservoirs for flood control alone can be an economic proposition in England, and says that they must serve other purposes as well in order to make them economically justifiable. The article is to be continued in the next issue.

No. 4270—November 12, 1937.

AMERICAN HIGHWAYS AND HIGHWAY PRACTICE. **Tratman.**

This article deals with various methods of construction adopted on American roads. Some features of earthwork for highway construction are described and the construction of concrete roads is treated in greater detail. Compacting the concrete by electric and pneumatic vibrators is used extensively. Conclusions arrived at with regard to the use of vibration from tests conducted by the United States Bureau of Public Roads are given. Stages in the construction of a concrete highway are described and illustrated. Various types of longitudinal and transverse joints used are depicted and briefly described. The methods of curing the concrete are also mentioned.

FLOOD CONTROL AND STREAM FLOW REGULATION. Williams.

Continued from previous issue. The author outlines preliminary computations necessary in the investigation of reservoir sites and capacities. The relationship between the capacity of a storage reservoir and the rate of discharge that can be maintained from it is discussed, and curves for this relationship applicable to British upland catchments are reproduced. Off-flow curves for various catchments are given from which the normal annual run-off for catchments with different annual rainfall may be computed. The maximum flood at any point in a catchment may be produced either by very intense rainfall on a comparatively small area or by long continued rainfall over a large area. The author explains the method of computing peak flood discharge over a catchment for intense rainstorm and gives formulæ developed for peak rates of flood flows on Thames and Severn catchments. He then describes the possible reservoir sites on the Severn and the Thames which have been investigated and are found to be the most promising. He gives the total capacity of each reservoir, the storage capacity that would be reserved in each reservoir for regulating the flow of rivers, the estimated mean annual off-flow from the catchment to the reservoir, and the constant discharge that could be maintained from it. He also gives estimated inflow to and outflow from the proposed reservoirs in probable maximum floods which show that they would be very effective in reducing the intensity of local floods.

NEW HYDRO-ELECTRIC POWER STATION IN JAPAN. **Taji.**

The Shinano, the largest river in Japan is to be utilized for the generation of power. A new hydro-electric power station is now under construction where five sets of 60,000 H. P. water turbines and 31,000 K. W. alternators are to be installed. Brief details of the turbines and alternators are given.

No. 4271—November 19, 1937.

AMERICAN HIGHWAYS AND HIGHWAY PRACTICE. **Tratman.**

Continued from previous issues. Roads paved with vitrified bricks are described, and the manner of laying the brick, paving and filling in the joints are briefly outlined. Specifications in use for brick pavement construction and standard dimensions of bricks are given. Bituminous pavement construction as practised is then described in some detail. Proportions of graded stone, sand and asphalt used for the base and top courses of a Michigan highway are given as a typical example of mixtures used. Some features of new types of bridges which have been built on the new roads are then briefly discussed.

No. 4272—November 26, 1937.

AMERICAN HIGHWAYS AND HIGHWAY PRACTICE. Tratman.

Concluded in the present issue. This article deals with highway illumination, highway signs and guards, and landscaping as existing on American highways.

No. 4273-- December 3, 1937.

PRESERVATION OF THE NILE. Newhouse.

The Blue Nile is the chief source of water in Egypt and the Sudan. Practically the whole of the catchment area of the Blue Nile is in Abyssinia and consists of a savage and sparsely populated country covered with forest, scrub and grass. Under Italian control, the development of this tract is likely to be hastened. The author, who was late Inspector General of Irrigation in the Sudan, discusses in this article the future effect of the development of the catchment area of the Blue Nile in Abyssinia on the regime of the river and on present irrigation conditions in Egypt and the Sudan. In the words of the author "if Abyssinia becomes quiet and peaceful, and the cattle and goats increase, the mountains and plains will be denuded of trees and grass, the country side will be torn to bits by torrents, the discharge of the Blue Nile will be a monstrous torrent every year, and its whole regime will be altered to the certain detriment and possible ruin of Egypt". The present conditions of flow of the Blue Nile and the flood period are described. With a denuded catchment area, the rainfall would result in a 100 per cent. run-off as soon as it occurs; there would be no absorption and subsequent seepage as at present, and in the three winter months of January, February and March, the river might be quite dry. The silt content of the river in flood is likely to be much larger than at present and the reservoirs on the Nile would be choked with silt in a comparatively short time. The Aswan reservoir at present takes three months to fill with the comparatively silt-free waters of the falling Nile flood but in future the flood will drop away like a stone so that reservoir filling operations will be made almost impossible to carry out. Over and above all these changes the question of flood protection will become more serious and urgent. The denudation of the catchment in Abyssinia would double the total run-off of the Blue Nile by increasing it from 20 per cent. of the rainfall as at present to 40 per cent. The author suggests that the obvious thing to do is for Egypt and the Sudan to invite Italy's attention to the matter and to arrange for some of their engineers to study the technique of anti-erosion measures first-hand in America so that steps may be taken to prevent the ruin of the Blue Nile catchment in Abyssinia, which will mean a great disaster for Egypt and the Sudan.

THE PUBLIC WORKS EXHIBITION.

Some of the exhibits are described, which include a mechanical shovel. The machine is mounted on a specially built lorry chassis, the power unit of which also provides power for the operation of the excavating functions. Another exhibit was a new type of electric concrete vibrator.

No. 1274—December 10, 1937.

THAMES FLOODS. Newhouse.

In this article are discussed the causes of floods on the Thames, their probable intensities, and possible measurements of protection. The Thames is divided into two distinct sections by the Weir at Teddington which marks the limit of tidal effect on the river. Floods above Teddington are caused by rain and snow on the catchment. From data of widespread rainstorms in the past in England, a rainfall of 3 inches in 24 hours on an area of 2,000 sq. miles is possible. Records of rainfall and run-off in the Thames Valley show that run-off in January and February averages 62 per cent. of the rainfall, it is reasonable to assume that this might be as high as 80 per cent. in long wet spells when the ground is saturated. In that case the discharge due to a 3 inch rainfall in 24 hours would be 40 million gallons per day past London bridge. This would be in addition to the normal quantity passing over Teddington Weir; the maximum ever recorded being 20,000 million gallons. The total possible discharge would thus be 60,000 million gallons a day. On January 6th and 7th, 1928 there was a very disastrous flood in the Thames which caused serious damage and loss of life, yet the estimated discharge of that flood was only 12,500 million gallons, or one-fifth of what might be expected in an exceptional year. Below Teddington weir the conditions are still more aggravated by the tide factor. At present, each county along the river is responsible for protecting its own length of water line. The disadvantages of this procedure are discussed and the necessity of one central authority for flood control operations on the whole river is emphasized.

JOURNAL OF THE INSTITUTION OF CIVIL ENGINEERS.

No. 8—October 1937.

MODERN METHODS OF STRUCTURAL DESIGN. **Baker.**

This is the Institution Lecture to students for 1936-37 and deals with recent developments incorporating new ideas in the design of structures. Prof. Hardy Cross' new method of stress analysis is briefly outlined and its application is illustrated with reference to a cantilever frame. Principles in the design of stanchions and beams are discussed and an outline of the new method of design is given in each case.

CORRESPONDENCE ON PAPERS.

THE RESTORATION OF THE BREACH IN THE RIGHT GUIDE BANK OF THE HARDINGE BRIDGE.

Correspondence on the above paper which was published in the November 1936 issue of the journal (See Bulletin No. 6, page 41) Mr. C. C. Inglis of Poona refers to the model experiments in progress at the Khadakvasla Hydrodynamic Research Station in connexion with safeguarding the Hardinge Bridge, and says that it has been possible to reproduce the breach accurately, although the author of the original paper has stated that the actual cause of the breach will remain an unsolved problem. He goes on to discuss the cause of the breach and criticizes the construction of the Damukdia guide bank which was undertaken as an emergency measure. Some conclusions drawn from the experiments at Khadakvasla are given and it is suggested that the basic principles of Bell and Spring with regard to river control, though sound, required revision and amplification in the light of present knowledge. The author in reply to Mr. Inglis' remarks says that the Damukdia bund was built after the considered opinion of very many engineers had been taken, and was now being extended. He thought that the model experiments carried out by Mr. Inglis had given, and would continue to give, most valuable information with special reference to specific details such as pitching of piers, launching of aprons, etc. He felt however that over an extended length of 50 miles of an alluvial river where so many factors were involved, the investigation of the behaviour of a river like the Ganges by means of a model was not perhaps the best method; experience together with observation, combined with common sense and an application of general hydraulic principles, could supply the knowledge necessary for designing training works, aided perhaps in matters of detail by knowledge acquired from model experiments.

THE LOWER ZAMBEZI BRIDGE AND THE CONSTRUCTION OF THE LOWER ZAMBEZI BRIDGE.

These two papers were published in the January 1937 issue of the journal (See Quarterly Bulletin No. 5, pages 37 and 38). Comments on these papers are concerned with the depth of foundations of the bridge piers, skin friction in the design of pier well foundations, sinking of wells, well curbs, and economical length of spans.

THE SECOND-STAGE DEVELOPMENT OF THE LOCHABER WATER-POWER SCHEME.

This paper was published in the February 1937 issue of the journal (See Quarterly Bulletin No. 5, page 39). Comments on this paper refer to cracks in concrete dams, construction joints, the use of gunite on the upstream face to deal with the problem of cracks due to shrinkage and temperature stresses, various methods of prevention of permeable shrinkage cracks grading of aggregates for mass concrete dams, and siphon spillways.

FLOOD-HYDROGRAPHS.

This paper was published in the March 1937 issue of the journal (See Quarterly Bulletin No. 6, page 44). Comments are mainly directed to the formulas proposed in the paper and the catchment areas to which they are applicable.

THE FLOW OF THE RIVER SEVERN, 1921—36.

This paper was published in the June 1937 issue of the journal (See page 43 of Quarterly Bulletin No. 7). Mr. Griffith points out that the best method of measuring and recording discharges depended on the local conditions and gives his experience with the discharge observations of the Sarda River at Tunakpur in the United Provinces. He gives a method of obtaining a stage discharge curve and discusses the gauging of the Great Ouse and its tributaries, for which he was responsible.

Mr. Gerald Lacey of Roorkee states that though meters are accurately rated the discharge by the cup type meter was 1·5 per cent. greater than by the screw type meter. In India the use of current meters in measuring canal discharges is steadily increasing. Adjustable velocity rods are still largely used in the United Provinces, Bombay and Sind and they gave the mean velocity in a vertical with considerable accuracy. In India, for many years to come reliance in river flood discharges would of necessity be placed on central surface velocity observations with floats.

Correspondence on the following papers is also published :—

SIMPLE EXPERIMENTAL SOLUTIONS OF CERTAIN STRUCTURAL DESIGN PROBLEMS.

SHIP CANALS UTILIZED FOR DRAINAGE.

EFFICIENCY TESTS OF LARGE MODERN PELTON WHEELS.

PRE-STRESSING BRIDGE GIRDERS.

THE SALONIKA PLAIN RECLAMATION-WORKS.

THE LAKE COPAIS, ITS DRAINAGE AND DEVELOPMENT.

APPLICATION OF VIBRATION TO THE PRE-CASTING OF CONCRETE.

KINCARDINE-ON-FORTH BRIDGE.

No. 1—November 1937.

PRESIDENTIAL ADDRESS.

Mr. Sydney Bryan Donkin, President of the Institution for the coming year, dealt with developments in electricity in his address. A comparison is made between the methods of generating electricity by steam, oil and water power. He states that where the load factor is high and peak load can conveniently be dealt with, hydro-electric schemes can be used economically.

A PRE CAST REINFORCED-CONCRETE UNDERLINE RAILWAY BRIDGE. Follenfant.

This paper deals with the design, construction and erection of a reinforced concrete underline railway bridge carrying the Piccadily line of the London Passenger Transport Board over the ticket hall of the reconstructed South Harrow station. The noteworthy feature of this bridge is that it was constructed complete in a temporary position adjacent to the tracks and was rolled into position. The bridge has a span of 41 ft. 9 inches and consists of six T beams at 3 ft. 9 inch centres supporting the deck slab. Five transverse beams are provided for lateral stiffness and to equalize the deflexion amongst the longitudinal T beams. Details are given of construction, erection, progress of work, quantities, etc.

IMPROVEMENTS IN THE HARBOUR OF PORT LOUIS, MAURITIUS. Austen.

Harbour improvement works at Port Louis comprising dredging, reclaiming a shallow part of the harbour, and building deep water quays are described in this paper. The area reclaimed was a large patch covered with mud and sand with an average depth of 6 ft. of water. A rubble embankment was first built enclosing the area and a masonry faced parapet wall on a reinforced concrete slab foundation was built on the rubble embankment to retain the dredged material, which was deposited behind the embankment. The deep water quays were built on reinforced concrete piles 14″ × 14″ square and 55 ft. long.

THE RECONSTRUCTION OF THE INCHCAPE BRIDGE, BENGAL AND NORTH WESTERN RAILWAY. Ravenhill. Wilson.

This railway bridge on the Gogra River in Bihar consists of eighteen 200 ft. through-girder spans on brick piers founded on circular brick wells sunk 97 ft. below low water level. The piers are 36 ft. high above low water level. In the Bihar earthquake of January 1934 two of the girders were overthrown and fell into the dry bed of the river. The reconstruction of the two damaged spans is described in this article. For one of the damaged spans, an exactly similar span of a disused bridge about 200 miles away was used, and the other span was made up from the undamaged members of the two fallen spans.

THE REDUCTION OF CARRYING CAPACITY OF PIPES WITH AGE. Colebrook. White.

"This paper outlines a theory based on the Von Karman-Prandtl resistance law together with the hypothesis that the hydraulic deterioration of pipes is due to increase in surface roughness, and that the size of the roughness irregularities grows in direct proportion with time. A formula is developed giving the relation between the age of a pipe and its carrying capacity and a tabular statement gives the rate of growth of irregularities under various conditions."

THE DISCHARGE OF SMALL SUBMERGED SHARP-EDGED ORIFICES. Cornish.

The experiments described in this paper were carried out with the object of discovering whether the co-efficient of discharge of a submerged orifice is affected by the value of the head on the downstream side. A brief description of the apparatus used is given and the results are discussed. The results of other investigators are compared with the results obtained by the author and the following conclusions are arrived at:

1. At Reynold's numbers less than 3,500 the value of the downstream head has a considerable influence on the co-efficient of discharge of a square submerged orifice which is therefore unreliable as a measuring device within this range.
2. At Reynold's numbers higher than 3,500 the value of the downstream head has a negligible effect provided that the dimensions of the orifice are small compared with those of the cross section of the channel into which it discharges.
3. A rise in temperature from about 50°F. to 95°F. results in a decrease in the co-efficient of discharge corresponding to the same Reynold's number.

WATER AND WATER ENGINEERING.

VOL. XXXIX.

No. 480—Midsummer 1937.

(Special Institution Number.)

BELLMOUTHED WEIRS AND TUNNEL OUTLETS FOR THE DISPOSAL OF FLOOD WATER. Binnie.

The usual method adopted for the disposal of flood water from a reservoir formed by a dam is the construction of a weir over which the water flows into a channel leading to the stream below the dam. Owing to unsuitable configuration of the ground this means of disposing flood water may be very costly and in such cases an alternative method has been adopted whereby the water after passing over a weir of suitable length falls down a shaft into a tunnel discharging into the stream below the dam. The shafts at their intakes are shaped as bellmouths and this type of overflow is called a bellmouth overflow. The author in this article describes a number of bellmouth overflows built in England, America, China, New Zealand, and Singapore. Particulars of designs of these overflows are given in a table. Experiments with models carried out in connection with the design of some of these overflows are described and discussed. The experiments deal with the effect of entrained air, formation of vortex, influence on the vortex of a symmetric approach, influence of fins on the bellmouth, influence of radial piers, and influence of a curtain wall dividing the bellmouth into two semi-circular weirs. The model experiments in connection with the overflow of the Jubilee Reservoir in Shing Mun, China, are treated in greater detail. Conclusions arrived at from the study of the experiments are given, of which some of the important ones are as follows :—

1. Model experiments can predict approximately the behaviour of the prototype provided that the model ratio is not too small.
2. A steadier flow at high rates of discharge is obtained by using a conical shaft than with the type hitherto adopted.
3. A curtain wall extending across the waterway so as to divide the bellmouth into two semi-circular weirs is the best anti-vortex device.
4. The cross sectional area of the channel of approach should be such as to limit the tangential velocity to 3·5 ft. per second at any cross section.

No. 484—October 1937.

BURNHOPE RESERVOIR : DURHAM COUNTY WATER BOARD.

This reservoir which is situated at the extreme western part of the county of Durham has recently been opened. It is a water supply project consisting of a reservoir, eight miles of catch-water drains and other appurtenant works. A brief history of the project is outlined and the works are described. The reservoir is formed by an earthwork embankment 1,770 ft. long, 131 ft. high, and 800 ft. wide at the toe. There is a puddle core and a concrete cut-off trench 6 ft. wide with an average depth of 95 ft. The catch water drains consist of concrete and cast iron pipes varying in diameter from 15 inches to 48 inches with branch pipes to intakes. The eight miles of catch waters bring in an additional catchment area of 5,500 acres, the total catchment area being 9,980 acres. A tunnel diversion had to be constructed for diverting the river during the construction of the dam. The overflow works consist of an overflow weir, a bellmouthed swallow hole, and a tunnel. All these works are briefly described.

WATER SUPPLY OF BIRMINGHAM.

Principal features of the existing water supply works for Birmingham are described. These works include three solid masonry dams for storage and 73½ miles of aqueduct to carry the water to Birmingham. The dams are 610 ft., 528 ft. and 513 ft. in length, and 122 ft., 123 ft. and 120 ft. high respectively. The aqueduct consists of conduits and inverted syphons. The conduit lengths comprise about 12 miles of tunnels, and two longest being 4¼ miles and 2 miles long. The conduit is carried on masonry aqueducts across several minor valleys. The larger valleys are crossed by syphons, the longest being 17½ miles in length across the Severn Valley.

EVAPORATION. Bilham.

Methods of measuring evaporation losses, and recent investigations on the subject of evaporation are discussed in this article. In reviewing the practical significance of evaporation data, the author emphasizes the fact that actual losses may stand in very little relationship to the rate of evaporation as measured by an evaporimeter. Under natural conditions loss of moisture depends not only on temperature, humidity, and rate of movement of air, but also on rainfall. He illustrates his remarks by considering the run-off data of the drainage area of the River Thames at Teddington. A series of graphs showing rainfall, run-off and loss calculated rainfall minus run-off in the Thames drainage area for the years 1922 to 1934, and another showing evaporation from a tank at Camden Square are depicted. A comparison of the graphs shows that the one depicting loss is altogether dissimilar from the one showing evaporation at the Camden Square tank. They also indicate that actual evaporation is high in wet years and low in dry years which is contrary to what might generally be expected. The author has also advanced a formula for run-off from the Thames drainage basin derived from a study of the rainfall and run-off data.

No. 485—November 1937.

DETERMINATION OF THE YIELD OF WATER-BEARING STRATA.

"From experiments carried out by the U. S. A. Geological Survey it has been concluded that with the 'Thiem' method of calculating permeability of water bearing earth, pumping can be successfully utilised for determining the specific yield of a water table and that figures for both permeability and pumping can be derived from the same observations and at the same time. The experiments in question were conducted over a large area of sand and gravel by means of 80 borings of varying diameter disposed in six lines spaced radially and extending some 1,055 ft. from a well from which water was raised and measured. From curves plotted, rise and fall of level and amount of discharge in the sand and gravel strata could be ascertained".

Conditions necessary for a satisfactory application of the method are given.

VARIATION IN LOSS OVER CATCHMENT AREAS. Lloyd.

This article discusses a method of assessing loss by evaporation, transpiration and percolation that occurs on catchment areas in the British Isles in annual periods. Variations in loss over any catchment area can be associated with the variation in rainfall, temperature, sunshine and the geological strata. The author has produced a diagram in which variations in loss are related to variations in rainfall and temperature. He has obtained statistically the values of percolation per annum in inches for various kinds of strata. He also assumes a value for the variation of loss per 100 hours' departure from a standard number of hours sunshine. Given the data regarding average annual rainfall, normal temperature, the geological strata, and the hours of sunshine for an area, an approximate value of the loss can be computed with the aid of the diagram produced. Several examples are worked out to illustrate the method. The author mentions that this method is intended to arrive at a near value of the loss in the preliminary examination of an area for which no reliable records for stream flow are available. The exact loss can only be obtained from stream flow records owing to the number of factors involved.

THE BILLS BROOK DAM.

A brief description of the dam and the work done under the first and second contracts is given. The dam forms a reservoir on a branch of the Farmington River in Hartford, U. S. A. and was constructed for the Hartford Water Bureau. The dam is a curved earth-fill embankment with a concrete core wall, 2,075 ft. long, 137 ft. high and having maximum base width of 900 ft. The top width is 84·5 ft., and the freeboard is 15 ft. The upstream slope varies from 1 : 1½ to 1 : 4 and the downstream slope varies from 1 : 1¾ to 1 : 3. The upstream face is covered with rip rap and a tile drainage system is provided in the downstream portion. A concrete conduit extends through the dam and provides for delivery of compensation water to Farmington river.

RAINFALL, RUN-OFF AND LOSS IN THE THAMES BASIN. Bilham.

The author refers to his article on evaporation in the previous issue of this journal and gives a revised formula for run-off from the Thames drainage basin which is based on more extensive data than was taken account of in the formula given in the original article.

No. 486—December 1937.

EDITORIAL NOTES.

INFLUENCE OF FORESTS ON RAINFALL.

The influence of forests on rainfall is a debatable subject. A correspondent to the *Times* however supports the view that rainfall is influenced by forests and cites the cases of the islands of Zanzibar and Pemba in the Indian Ocean. In comparison with decrease of rainfall on the ascending coast of the mainland, Pemba should have a lower rainfall than Zanzibar whereas it is 13 in. greater due to the influence of its forests.

WEATHER AND WATER SUPPLY. Bilham.

Certain aspects of the study of past weather in relation to average conditions and variability, which are of vital importance to the water undertaker are discussed in this paper. Variation of rainfall in England during the past 37 years is studied and conclusions are drawn as to what may be expected in the future. Run-off in the Thames and Severn Valley are studied in some detail and formulæ for run-off derived from statistical analysis of available data are given. Variations in losses due to evaporation in these catchments are discussed. Water engineers usually adopt 80 per cent. of the normal as the rainfall of the three driest consecutive years in estimating the reliable yield of a catchment area. This figure of 80 per cent. is borne out by the results of studies of the drought period 1932—1935.

INLAND WATER SURVEY : SECOND ANNUAL REPORT (1936-37) OF THE COMMITTEE.

Extracts from the Report which has recently been issued are given. The progress of work concerning survey of underground water, work of Catchment Boards, recording of rainfall and preparation of rainfall maps, and preliminary examination of *individual river basins is described. Descriptions of the features of the basins of the rivers Ness, Tay, Ouse, Severn, Dee and Irvine, are given.*

MONTHLY REVIEW OF CURRENT LITERATURE.

METOHODS OF LOCATING SALT WATER LEAKS IN WATER WELLS. Water Supply Paper 796-A of the United States Geological Survey. Lavingston. Lynch.

Contains illustrated description of methods for determining place and extent of salt water leakages into wells in Texas and Florida. Four general methods are used. In the pumping method samples taken at measured time intervals while the well is being pumped show by their progressive change in salinity if salt water is being drawn in. In the velocity method suitable for use in artesian wells only, a current meter is lowered into the well and levels at which there are changes in the rate of upward movement of water are determined. These indicate possible salt water leaks. In the sampler method samples of water from different depths are analysed for chloride content. The electrical conductivity method is based on the fact that increase in conductivity is directly proportional to the increase in dissolved solids. Procedure and results of investigations are detailed. Proper construction to guard against salt water trouble is described.

LEAKAGE FROM ALBANY RESERVOIR STOPPED BY NEW DESIGN. Water Works Engineering, September 29, 1937. Smith.

Describes the method adopted in lining the distribution reservoir of the Albany water supply system to stop leakage. The lining is a combination of reinforced concrete and gunite to an overall thickness of 8 inches. Details of joints of slab units, and of slope joints are given.

VIZUGYI KOZLEMENYEK.

(In Magyar but containing English summaries).

VOLUME XIX.

No. 1—January-March 1937.

SOIL PROBLEMS IN EGYPTIAN IRRIGATION. Kotzmann.

With the basin system of irrigation practised in Egypt before the present perennial system, salt accumulation in the upper layers of the soil was prevented by annual flooding of the basins. Since the introduction of the perennial system with canals at high levels running throughout the year a constant rise in the ground water level in the Nile Valley has taken place. Free evaporation from this high water table takes place giving rise to salt accumulation near the surface. The soils which thus deteriorate are classified as black alkali soils and gypsum veined soils which are both impermeable to water. The reclamation of these deteriorated soils is a difficult problem. The installation of an intensive drainage system will help much but only as a preventive measure and special treatment is required for soils already deteriorated. Gypsum has some effect on black alkali soils while deep ploughing helps in the amelioration of the gypsum veined soil.

REGULATION OF THE KOPPANY BROOK; ECONOMIC CONSEQUENCES. Mantuano.

This brook was regulated in 1930-33 and as a result certain areas were reclaimed. The article compares the value of the increased production with the cost of the scheme and concludes that the regulation has been an useful investment.

DEVELOPMENT OF IRRIGATIONS IN 1936 ON THE TERRITORY OF THE LOWER-FEHERKOROS LEVEE COMPANY. Kienitz.

Describes irrigation operations on the territory of the levee company. Irrigation was carried out by pumping from the river with water wheels and centrifugal pumps. Costs of irrigation, and income, are given.

DEMAG NEWS.

VOLUME XI, B.

No. 2—August 1937.

Contains nothing of interest to irrigation engineers.

REVUE GENERALE DE L'HYDRAULIQUE.

(In (French.)

No. 16—July-August 1937.

I.—UTILIZATION OF THE PIEZOELECTRIC EFFECT OF QUARTZ FOR THE STUDY OF WATER HAMMER IN FULL PIPES.

II.—DEVICE FOR THE INSTANTANEOUS MEASUREMENT OF THE VARIATIONS OF DIAMETER OF THE PIPES.

APPARATUS FOR THE MEASUREMENT OF THE FORCE OF WAVES.

Experiments, on a Reduced Model, with a Sector Gate.

Conclusion.

The experiments which are described in this article show how valuable is research on reduced models for studying the problems of works with complex phenomena which are not easily susceptible of theoretical solution. They have permitted investigation of the forces required to manipulate the gate, the stability of the gate itself and the balancing couple, and several problems connected with the flow of the water, and the joints between the gate and the masonry.

How to Characterize the Intrinsic Variability of Rainfall.

The author of this article gives the result of an important analysis of the data from the pluviometric stations at Versailles, Lyon and Marseille. These interesting researches indicate that it is possible to apply in pluviometry in temperate regions the law of proportional effect.

TRAVAUX.

(In French.)

No. 54—June 1937.

The Control of Cement Qualities.

Bolomey.

In this article the author reviews and discusses the use of various tests to which a cement can be subjected. He examines in great detail the tests for mechanical properties, and describes a new method for their determination.

Re-inforced Concrete Structures. Does the use of Rapid Hardening Cement Increase the cost to any Appreciable Extent ?

No. 58—October 1937.

Study of the Removal of Alluvia from the head of a Canal by Scouring Apparatus, and Verification of the Results Obtained on a Reduced Scale Model.

Bonnet.
Blockmans.
Lamoen.

The general conclusion from the tests described is that the nature of the materials employed is of little concern, but the important factor is the period over which flow is allowed to take place.

THE GIRDER WITHOUT DIAGONALS FOR RIGID STRUCTURES. (VIERENDEEL GIRDER). Baes.

The article gives details of design of this type of girder.

METHODS OF THE STUDY OF WAVES. Larras.

This describes the methods used to study wave action in connection with the design of jetteis, etc.

THE EMPLOYMENT OF METAL SHEET-PILING IN COAST PROTECTION WORKS.

AGRICULTURE AND LIVE-STOCK IN INDIA.

VOLUME VII.

Part VI—November 1937.

THE BIOLOGICAL CONTROL OF INSECT PESTS. Isaac.

Insect pests injurious to crops are usually controlled by a variety of ways which may be classified as mechanical, cultural, chemical and biological. The biological method of control is based on the fact that insects are very often checked in their multiplication by other organisms which are their natural enemies. In this article the author describes some of these organisms and gives a brief review of biological control of insect pests as attempted in various countries.

A NOTE ON COMPOSTING ORGANIC MATTER BY THE USE OF CHEMICAL STARTERS. Gadgil. Hegdekatti.

This article embodies results of experiments undertaken to prepare organic manures by the use of different types of chemicals as starters. The need for this method was felt for localities where, due to the paucity of cattle, their excreta are not available for composting organic matter. The trials were made with dry and fallen leaves, twigs, rice husks, betel husks, rice straw, etc. It was found that in the absence of cattle, organic wastes could be composted with chemicals. Ammonium sulphate with calcium carbonate was found to act very effectively. Though this method is not cheaper than the method of composting with cattle excreta, it has some advantages amongst which may be mentioned the following :

(1) It is a much quicker method, taking only about three months as against ten months required for the usual method,

(2) It yields a final product very much superior to that given by the cultivator's method.

(3) The presence of lime in the product is good for acidic soils.

Economic quantities of the chemicals necessary are given and costs are also worked out.

CURRENT SCIENCE.

VOLUME VI.

No. 4—October 1937.

Contains nothing of interest to irrigation engineers.

No. 5—November 1937.

LETTERS TO THE EDITOR.

ASSIMILATION OF ATMOSPHERIC NITROGEN BY GERMINATING PEAS.

It is reported that in the course of certain studies carried out in the department of bio-chemistry, Indian Institute of Science, Bangalore, definite evidence has been obtained to the effect that there is direct assimilation of nitrogen from the air by germinating peas. Some of the quantitative results obtained are given and it is mentioned that further investigations are now in progress.

TESTING LABORATORY EXPERIMENTS ON MORTARS AND BRICK PIERS.

A series of investigations recently undertaken in the Testing Laboratory of the University College of Engineering, Bangalore, on brick piers, lean cement mortars, and composite mortar are mentioned, and some of the more inportant results are summarized. Tensile and compressive strengths against period of setting for mortars of neat cement to mortars upto 1 in 10 proportions are being investigated. Some of the results obtained are mentioned below:

(1) Lime mortar of 1 to 2½ proportions mixed with 10 per cent. of cement by volume shews an increase of compressive strength by 200 per cent. and of tensiles stres by 50 per cent.

(2) Strength of a brick pier with minimum thickness of joints of 1/8″ with 1 to 3 lime mortar is much less than with cement mortar of even 1 to 10 proportion.

THE FOREST RESEARCH INSTITUTE, DEHRA DUN. Sabharwal.

A short history, with an account of the present activities of the Institute is given herein. The Wood Technology Section, Timber Seasoning Section, and Timber Testing Section are carrying on useful work on timber as a building material. Information and advice on matters connected with timber are available at the Institute.

No. 6—December 1937.

Water Requirements of Crops. **Tamhane.**

Iyengar.

Chandnani.

Investigations were carried out in Sind to determine the exact water requirements of different crops in the Lloyd Barrage area. The investigations were concerned with the following aspects of the question:

1. Minimum quantities of water needed to produce normal yields of the more important crops.
2. The mode of distribution of the total quantity of water required by the crop during the growth of the crop.
3. The effects of a larger or smaller supply of water than the optimum.
4. The effect of different total quantities of water on soil and plant performance.
5. The optimum soaking doses.

The results of some of these investigations are given in this article. The experiments were conducted with two varieties of wheat and two varieties of cotton and covered a period of seven years. Duties of 100 for kharif and 200 for rabi were taken as standard for purposes of comparison as recommended by the Baker Lane Report. The yield obtained with different quantities of water is tabulated. The experiments show that duties of 100 for cotton and 200 for wheat are the optimum and cotton is definitely benefited by a more intensive supply of water during the later stages of its growth than with an even distribution at equal intervals of time.

INDIAN AND EASTERN ENGINEER.

Vol. LXXXI.

No. 4—October 1937.

Trends in Dam Design, Part I. Johnstone Taylor.

This is the first of a series of three articles in which present day tendencies in the design of dams are discussed. Recent studies and investigations have placed the problem of the design of dams on a more scientific basis. The mass concrete gravity dam of the present day with modern facilities of mixing and placing concrete is a cheaper and safer structure as compared to its predecessor of cutstone masonry construction. The arch dam came into being as a result of an attempt to evolve a type of structure more economical than the gravity dam. Some important factors in the stability of mass gravity dams which have come to light in recent years are discussed. These include uplift pressure, sliding action, and seepage. A few typical examples of gravity dams of recent construction are mentioned and their main features described. Amongst these are the Laggan Dam of the Lochaber water power scheme, the dams of the Galloway water power scheme, the Chambon dam in France and the Mettur Dam in India. The Chambon Dam is the largest dam of its type in Europe being 450 ft. high. The author also mentions that although designated as barrages, such structures as the Lloyd Barrage in Sind, and the Nile Barrages are in reality dams of no mean height with problems in design and construction similar to those encountered in the case of dams, though serving a different purpose.

REGIONAL WATER SCHEME COSTING £45,000,000.

The principal details of the Los Angeles Aqueduct (Colorado River Aqueduct) which is designed to convey water from the Colorado River to towns in Southern California are given herein. The Parker Dam is under construction across the Colorado River at a point 155 miles below Boulder Dam. It is proposed to construct the headworks and intakes for a 239 miles long trunk aqueduct at Parker Dam. The aqueduct comprises 46 tunnels averaging a total length of 85 miles, 75 miles of concrete lined open channels, 55 miles of concrete conduits in open cut, and 24 miles of siphons. The longest tunnel will be 13 miles in length. There will be 5 pumping stations for lifting the water to the high lands for which it is intended. The plant at each station is intended to be of nine units, each with a capacity of 200 ft. sec. the lift ranging from 150 ft. to 440 ft. (Also *see* page 79 of Bulletin No. 7.)

METTUR HYDRO-ELECTRIC DEVELOPMENT.

Dorai Rajan.

The first stage of the Mettur Hydro-Electric Scheme will be completed in October. This article describes in brief the scheme as completed so far and gives a few interesting details regarding the power house and the generating plant. The next big scheme under contemplation by the Madras Government is the Papanasam Hydro-Electric Scheme in the Tinnevelly District which is estimated to cost about 2 crores of rupees.

STEEL RESEARCH LABORATORIES AT JAMSHEDPUR.

The Tata Iron and Steel Company have recently opened their new Technical Control and Research Laboratories which are the first of their kind in India. Details of the building housing the laboratories and their equipment are described. Testing of metals and other research work connected therewith will be carried out at the laboratories.

IRRIGATION IN INDIA.

A review of the press note of the Government of India published recently dealing with the progress of irrigation in India. Some facts and figures regarding the extent and importance of irrigation works in India which are not known to many are presented in this note. One sixth of the total crops produced in British India is irrigated by the irrigation systems constructed during the British Administration. The area irrigated in India exceeds the combined total of that in the six countries which stand next amongst the world's largest irrigating countries. There are about 79,000 miles of Government channels irrigating over 40 million acres in British India. Irrigation works of India rank amongst the largest in the world. The Sukkur Barrage system in Sind commands an area one and a half times that of Palestine. The Sutlej Valley Project in the Punjab serves an area exceeding the total cultivable acreage in Egypt and the Sudan. The Sarda Canal in the United Provinces commands an area equal to that acreage. The Ganges Canal commands a gross area of 5½ million acres.

In length of waterways, the Lloyd Barrage system leads with its 6,500 miles of channels. The Cauvery Delta System is 5,400 miles, and four other systems total 3,000 miles each. The Ganges Canal has 4,000 miles of waterways.

India has also many gigantic dams amongst which are mentioned the Lloyd Dam at Bhatgarh, in the Bombay Presidency, the Wilson Dam at Bhandardara also in the Bombay Presidency, the Nizam-Sagar Dam in Hyderabad State which is nearly 3 miles long, and the Mettur and Periyar Dams in Madras.

The total capital outlay on these works up to date is in the neighbourhood of 150 crores of rupees, and the value of the crops raised with the assistance of these works is 100 crores annually. The gross revenue amounts to 13 crores and the working expenses amount to 5 crores. The net revenue is 8 crores of rupees which represents a return of 5¼ per cent. on the capital outlay. The criterion of productive irrigation schemes is that they should ensure a net return of 6 per cent. on the capital outlay, but besides direct return, irrigation schemes are also responsible for an indirect return in the shape of increase in land revenue, railway receipts, postal and custom receipts, etc. The Central Board of Irrigation has launched a survey to estimate the gross value of irrigation schemes in the way of revenue from all sources with a view to obtain capital for new projects on easier terms.

A new development in irrigation in India is the production of power at canal falls and using it on a large scale for irrigation from tube wells. Electricity is being generated at the Mettur Dam and a comprehensive grid system is in operation in the United Provinces. A tube well irrigation system has also been initiated in the United Provinces.

A proposal is also under consideration to set up a Central Research Station under the aegis of the Central Board of Irrigation to deal with the many and varied problems that arise in irrigation engineering.

MISCELLANEA.

IRRIGATION PROJECT.

A project estimated to cost about two crores of rupees has been taken in hand by the Baroda State Government. It includes a masonry dam across the river Jhankari.

POWER PROJECT.

The Mysore Government have accorded sanction to the Shimsha and Jog Hydro-Electric Schemes which are estimated to cost approximately 56 lakhs and 200 lakhs of rupees respectively.

No. 5—November 1937.

TRENDS IN DAM DESIGN—PART II. Johnstone Taylor.

Various types of arch dams are discussed in this article. Main principles of design are briefly touched upon and some existing dams of this type are described. Construction procedure of one of the dams is briefly described as a typical example.

THE MARCONAHALLY RESERVOIR PROJECT IN MYSORE. Dorai Rajan.

Details are given of a proposed reservoir project in Mysore for irrigation storage. The reservoir will be formed by a masonry dam 446 ft. long flank by two earthen embankments 2,508 ft. and 2,310 ft. long across the river Shimsha. There will be one irrigation sluice on the left bank 33 ft. above the river bed capable of discharging 250 cusecs, for irrigating 10,000 acres. The main channel is 18⅝ miles long with a bed width of 18½ ft., depth of water 4½ ft. and slope of 2 ft. per mile. Brief details are given of calculations for yield from the catchment and capacity of the reservoir, and costs of works.

SARDA CANAL SCHEME.

A brief note describing important features of the Sarda Canal Project based on a recently published press note. (*See* page 115 of Bulletin No. 7).

No. 6—December 1937.

STORSTROM BRIDGE.

Describes the important features of this bridge and gives brief details of its construction. (*See* under "Civil Engineering and Public Works Review" for September 1937 in this Bulletin.)

A NEW THEODOLITE.

A new and improved type of theodolite of recent manufacture is described, and its special features are mentioned.

WELDING OF BRIDGES IN INDIA.

Electric arc welding was introduced in the bridge department of the North Western Railway about six years ago. The plants in use and some recent works where welding has been successfully carried out are mentioned.

BRIDGES.

Features of portal frame bridges, a number of which have recently been built in Oxfordshire, are discussed. The advantages of this type of bridge over the ordinary girder bridges are described.

TRENDS IN DAM DESIGN—PART III. Johnstone Taylor.

Earth and rock fill dams are dealt with in this article. Recent practice in earth dam design and construction is described and two recently constructed dams, namely, the Hume Dam in Australia and the Taf Fechan Dam in South Wales are briefly described as typical examples. Rock fill dams are of comparatively recent origin. Features of this type of dam are described with reference to recent structures which include the Treig dam in Scotland and the Shing Mun Dam in China.

THE STUDENTS SECTION :

ENGINEERING ESTIMATES, CONTRACTS AND SPECIFICATIONS. Antia.

Specifications for Coffer dams, well foundations and blasting operations with explosives are given.

THE INDIAN CONCRETE JOURNAL.

VOL. XI.

No. 10—October 1937.

RECENT DEVELOPMENTS IN PILE FOUNDATIONS. Upson.

The purpose of this paper is to review and discuss in detail methods and developments in the field of concrete piling for foundations. There are two classes of concrete piles, the precast and the cast-in-situ. In the former the recent developments are few. In the later there have been improvements and advancement that are significant to the engineer. The cast-in-situ piles are of two types, the shell type and the shell-less type. In Europe and the far east, the precast and shell-less type are favoured. Several types of shell and shell-less concrete piles of recent development are described and the advantages and disadvantages of each are discussed. Results of tests on six types of pile driven on the site of the United States Court House, New York City are given. It is pointed out that the shell type of pile is more favoured by engineers and consequently much effort and ingenuity has been expended in its development. A recent development is the use of pre-cast concrete piles for providing watertight walls, and a reinforced concrete sheet pile sea wall in Venezuela is described as an example. Several methods and materials have been developed for making the surface of concrete exposed to the action of water waterproof. These include surface coating with asphalt, tar, heavy oil, etc. These methods are briefly outlined. Considerations of load and nature of foundation which should govern driving of piles of different types are discussed.

THREE SPAN REINFORCED CONCRETE BRIDGE DESIGN IN THE ISLE OF ELY.

Hill.

This article is continued from the previous issue and describes the design of a three span reinforced concrete bridge with cantilevers and suspended slab centre span. Details of calculations for the design of the various members of the structure are given.

TESTS ON SHRINKAGE OF CONCRETE.

Shank.

Portland cement shrinks when it is exposed in relatively dry places. A shrinkage tendency in combination with some restraining agency such as reinforcing steel develops into a condition of stress. When shrinkage of concrete takes place in reinforced concrete. stresses are set up (tension in the concrete and compression in the steel), which may be mitigated somewhat by the plastic flow of concrete. The plastic flow of concrete is the action of deformation of concrete without the development of proportionate stress under some deforming agency, so far, much of the research work on shrinkage deals with the total amount of shrienkage and not with the rates of shrinkage at various ages. This is important because the strength and plastic properties of concrete vary with age, and rates of shrinkage must vary as well. In this article are presented observations of shrinkage on a few plain concrete and reinforced concrete specimens carried out at the Engineering Experimental Station Ohio State Univertsity about 2 years ago. The specimens were made with five different cement water ratios. After 28 days at 70 deg. F. and 100 per cent. humidity the specimens were put into room atmosphere and measurements were taken on them for 500 days. The shrinkage of plain concrete specimens has been shown graphically in millionths of an inch per inch for 500 days. In the case of reinforced concrete specimens, the contraction of the steel was measured by means of the strain gauge. The total shrinkage stress in the reinforced concrete as computed from a formula given by the author is also shown graphically. Results as shown by the curves are interpreted and discussed in some detail.

TRENDS IN DESIGN AND CONSTRUCTION OF CONCRETE PAVEMENTS. Gilkey.

Important factors which should be taken into consideration in modern concrete road design are discussed in this article. These include drainage, joints, and control of construction operations. Requirements for a highway for speeds of 60 miles an hour are laid down. Various types of joints, their spacing and dowelling of joints, subgrade treatment, and control of concrete quality are discussed.

No. 11.—November 1937.

DESIGN OF ARCH ROOFS. Terrington.

The object of this article is to describe the methods of calculating bending moments, thrusts, and shears at any point in the type of arch generally used in roof work and to illustrate their use in practice. It is the first of a series of two articles published in "Concrete and Constructional Engineering", see Quarterly Bulletin No. 7, pages 30 and 32.

THREE SPAN REINFORCED CONCRETE BRIDGE DESIGN IN THE ISLE OF ELY. Hill.

This is the final article of a series of three describing the design of various types of reinforced concrete bridges which are being built to replace some old bridges in the Isle of Ely. The two previous articles dealt with the design of a continuous three span type and a suspended slab centre span type with cantilevers. The present article describes the design of a continuous centre span bridge with end cantilevers. The central span is 45 ft. and the end cantilever spans are 16 ft. each. Details and calculations for design are given and the arrangement of the reinforcement is discussed.

FILLER JOIST FLOOR. Vasudevan

Filler joist floor is a flat reinforced concrete or reinforced brickwork slab floor in which steel joists or old rails are used as reinforcement instead of the usual steel rods. This article describes the method of design of floors of this type.

THE CONSTRUCTION OF A SMALL CONCRETE BRIDGE.

This article describes the construction of a small slab bridge such as may be used over narrow streams. No reference in made to the design of the slab and it is assumed that walls are already in existence along the banks of the stream for the slabs to rest upon. The clear span assumed is 8 ft. The preparation of the existing walls, construction of bearing beams resting on these walls to support the slab, shutterings calculating, length of and placing reinforcements, proportioning mixing and placing concrete and other practical details of the work are described. It is recommended that the centering of the slab should be left in position for at least fourteen days and the slab should be covered to keep it moist for at least 7 days.

POLISHED *in situ* FLOORS, WALLS AND PRECAST CONCRETE. Burren.

Describes the process of obtaining an evenly polished surface on concrete floors or walls. The polished surface is more easily cleaned and more hard wearing, and lends itself to artistic treatment with the use of various coloured cements and aggregates.

No. 12.—December 1937.

NOTE ON RECONSTRUCTION OF MILES 20-29, SITAPUR BAHRAICH ROAD. O'Dowd.

Construction operations on the reconstruction work which consisted of laying concrete tracts for heavy bullock cart traffic on one side of the road are described herein.

THE CHAMBON DAM, FRANCE. Rich.

This is a concrete gravity dam constructed in France. Details of construction operations are described. Cement was carried to the site of the dam by a cableway 6½ miles long extending from a railway terminus to the site. The layout of the concrete plant is described. Details of drainage galleries, contraction joints and other accessories are given. The dam is 960 ft. long, 440 ft. high and 230 ft. thick at the base. It will create a reservoir impounding 1,900 million cu. ft. of water.

A Road Design Supplement is included with this issue which gives extracts from a paper by Mr. R. Trevor Jones, Superintending Engineer, Punjab entitled "Some notes on the layout of rural and suburban roads in the Punjab". Illustrations of sections of various roads in India, Germany, Holland, Italy and Belgium are also included.

INDIAN ENGINEERING.

VOL. II.

No. 4.—October 1937.

NOTES AND COMMENTS.

MYSORE ELECTRIFICATION.

An important scheme for the generation of electricity is shortly to be undertaken by the Government of Mysore. The proposal is to construct a dam across the river Shimsa near Sivasamudram where there is a fall of about 600 ft. Another power generation scheme is also under consideration at the famous Jog falls in Mysore.

MEGHNA BRIDGE.

A railway bridge is under construction across the river Meghna in Eastern Bengal, on the Assam Bengal Railway. It consists of seven mid-stream spans of 336 ft. and six approach spans of 105 ft. each. The piers are built on well foundations. All the steel work for the bridge has been manufactured in India.

No. 5—November 1937.

EDITORIAL.

The editor reviews in brief the subjects discussed at the annual meeting of the Central Board of Irrigation held in Delhi in early November.

NOTES AND COMMENTS.

BIHAR POWER SCHEME.

It is reported that the question of generating electricity in the Province of Bihar with a view to providing tube-well irrigation in rural areas is being considered by the Finance Minister.

INDIAN IRRIGATION PROBLEMS.

Further comments on the annual meeting of the Central Board of Irrigation held in Delhi early in November.

CURRENT NEWS.

CAWNPORE WATER SUPPLY.

During recent discussion on the Cawnpore Municipal Board's proposals for the extension of its water-supply scheme, Mr. M. R. Richardson, Chief Engineer of the Irrigation Department agreed to 20 million gallons of water per day being supplied from the Lower Ganges Canal provided the Board increased the carrying capacity of the existing channel.

CONSIDERATION OF SILT IN THE DESIGN AND MAINTENANCE OF OPEN EARTHEN CHANNELS.

Khanna.

In this article the author discusses the silting of irrigation channels and measures to eliminate conditions which tend to silting up of such channels. The universally accepted conception with regard to silting is that the greater the slope and higher the velocity of flow in any channel the greater must necessarily be the power of transporting heavy particles of silt. This conception is simple and demonstrably true but its application to the solution of silting problems is not so simple. A study of the mean velocity formula for earthen channels shows that if velocity alone were the requisite condition for eliminating silt from channels, the objective could be much better attained by building narrow and deep channels than by making channels with steep slopes. Steep sloped channels have a tendency to draw into them coarse silt, and to widen themselves by cutting the sides, which render them liable to be silted up. The author then discusses the action of recently developed silt excluding devices. These devices prevent the heavily silt laden water nearest the bed from entering the offtaking channel but they have their limitations. If the silting trouble is due to coarse silt, such devices may be successful. But the author maintains that silt troubles are not infrequent on channels in tail reaches where the silt is not coarse. He believes that it is not the heavy grade of silt but conditions favourable to silting which cause silt troubles. In his opinion, elimination of silting troubles may be attained by designing offtaking channels with a free fall at their heads. He discusses how the provision of a large drop into an off taking channel from the parent helps to eliminate silting Broad crested flames with clear standing waves are quite as good as free falls.

STUDY OF THE FORMULA $Q=2\cdot05\ LH^{1\cdot5}$ — Khushalani·

This empirical formula frequently employed for calculating the waterway required through flumed structures working under drowned conditions is shown by the author to lead to erroneous results when applied to the design of waterway for a regulator. The theoretical formula for a drowned notch with suitable values for the constant term gives more accurate results.

No. 6.—December 1937.

NOTES AND COMMENTS.

BIHAR FLOODS.

The Flood Conference in Bihar which concluded last month passed a resolution to the effect that the damage caused by the floods is usually aggravated by embankment and recommended amendment of the Embankment Act and constitution of a Flood Committee to advise the Government on flood problems.

LETTERS TO THE EDITOR.

Mr. Gurwachan Singh in a letter refers to experiments in the U. P. on the reduction of canal losses by the sodium carbonate process and says that the experiments were carried out in limited reaches and actual losses were less than ½ cusec of water. With the usual method of discharging observations it is difficult to calculate the exact percentage of saving in the canal losses.

CONSIDERATION OF SLOPES OF FLOW IN THE DESIGN AND MAINTENANCE OF ARTIFICIAL CHANNELS. — Khanna.

The author states that the consideration of adequate silt transporting slopes should not find any place at all in our code for design of artificial channels. Silt grades of natural channels adjust themselves according to the slopes of the country through which they pass. Steepest channels have the coarsest silts in them and have the most pronounced silting tendencies. He refers to his book "Theory of flow of water and hydraulics of rivers and canals" wherein the design of a 5,000 cusec channel for Northern India is discussed. Whatever the grade of silt in the parent river, a 5,000 cusec canal off-taking from the river designed to slopes as flat as 1/12000 or 1/16000 will remain absolutely clear of silt if adequately working head is provided for the canal. The silting up of flat sloped artificial channels in their head reaches in a natural process by which the flow of water and transportation of silt adjust themselves to the natural law. In designing artificial channels therefore we only need to provide for silting up in their head reaches by means of free fall feeding or feeding through broad crested flumes with sufficient drops to ensure a standing wave being maintained despite the silting up of the head reaches. After the question of slope is decided, formulæ or tables are used for fixing bed widths and depths, etc. Chezy's velocity formula with Kutter's co-efficients is perhaps the most accurate but the values of Kutter's co-efficients vary with the index of rugosity in the channels, which is difficult to determine. He recommends the use of a velocity formula, developed by him from data of channels used by Kutter and Ganguillet for working out their famous formula. In conclusion he quotes the example of the Lower Bari Doab Canal main line which "provides a warning against the unwisdom of designing slopes of artificial channels from considerations of size of silt particles in the parent river".

THE INDIAN JOURNAL OF AGRICULTURAL SCIENCE.

Vol. VII.

Part V.—October 1937.

AGRICULTURAL METEOROLOGY ; THE PREDICTION OF THE MINIMUM TEMPERATURE ON CLEAR DAYS AT SELECTED STATIONS IN INDIA.

Narasimhan.
Ramdas.

In this paper an attempt has been made to investigate the possibility of predicting by statistical methods the minimum temperature attained by the air at four feet above ground during clear weather from a knowledge of the maximum temperature and vapour pressure recorded on the previous afternoon. In northern India, abnormally low temperatures are usually associated with frost, which is so injurious to crops. By correlating data at 19 stations in India, an equation has been evolved giving the minimum temperature in terms of the maximum temperature and vapour pressure of the previous evening.

THE JOURNAL OF THE INSTITUTION OF ENGINEERS (INDIA).

Vol. XVII.

August 1937.

This issue contains the proceedings of the Seventeenth annual general meeting of the Institution held in Bombay in January 1937, the annual report for the year ending 31st August 1936, the presidential address, and addresses of Chairman of local centres. Mr. M. C. Bijawat, Chairman of the United Provinces centre in his address refers to the progress in irrigation during the past eighty years. He draws attention to the losses in transportation and distribution of irrigation water and mentions that only of 40 per cent. of the water actually reaches the field. He refers to the investigations in progress in various Provinces to evolve suitable type of lining so as to reduce this loss. Cultivators also due to ignorance of water requirements of crops fail to utilize usefully the water they receive. In the tube well system where water is sold on a Volumetric basis, one cusec of water irrigates 4 to 5 acres whereas on the canal systems one cusec irrigates about 2 acres. Research on the best means of distribution and assessment has been going on for some time but as yet no successful system has been evolved. These problems require the serious attention of every irrigation engineer.

The following papers are also included in this issue of the journal:—

THEORETICAL INVESTIGATION AS TO THE MOMENTS AND SHARES IN A RIGID FRAME CONSISTING OF TWO STANCHIONS WITH FIXED FEET AND CONNECTED BY A CROSS BEAM. Sanyal.

This paper gives a method of finding out the horizontal thrust, vertical reaction and moments at the bases of the rigid frame by the principle of least work.

REMODELLING THE CHANNELS AND SLUICES IN THE CAUVERY DELTA. Pillai.

The object of this paper is to describe briefly the field operations and calculations made in the remodelling the channels and sluices of the Cauvery Delta. The Cauvery rises in the Western ghauts and flows eastwards into the Bay of Bengal. At the head of the delta the river trifurcates into three branches the Coleroon, the Cauvery and the Vennar. The Coleroon is the main channel of the river and carries the bulk of the floodwaters into the sea. The Cauvery and Vennar are the principle arteries for the delta irrigation and they divide and subdivide into innumerable branches which form a net work of distributaries all over the delta. Irrigation in the Cauvery delta dates back to very ancient times and there is evidence to show that these distributaries traversing the delta are not natural branches, but properly aligned channels running on the highest levels. Irrigation in the delta is carried out by means of sluices in the distributaries and irrigating channels leading therefrom to the area to be irrigated. The rivers in the delta have silted up progressivly and the sluice have very large openings and have also silted up considerably. Other defects in the delta irrigation system include absence of regular supply, disproportionate supply in upper and lower reaches, and occasional floods. Some of the defects will be removed by the operation of the Mettur Dam. Remedies are suggested for silting trouble in the rivers and channels in the delta. The best treatment is considered to be the training of the rivers so that they may flow in uniform channels of curtailed width. The remodelling of the sluices was also necessary in view of their openings being very large in proportion to the area to be irrigated and also because of their having silted up. The principles adopted in remodelling the sluices are set forth and the field work done is described. A duty of 45 was adopted for the remodelling, and the sills of the sluices were raised to conform to the silted bed in front and rear of the sluices. Calculations of vent sizes are given and also a typical example of "Report and Hydraulic Particulars for Remodelling a Sluice." (See Bulletin No. 5, page 12.)

THE DESIGN OF MASONRY GRAVITY DAMS. Williams.

This paper was awarded the Viceroy's prize for the year 1936. In his introductory remarks the author says that the problems of distribution of stresses in masonry dams and their stability have formed the subject of much theoretical and practical research during the last 80 years but no standard profile that has met with general acceptance has hitherto been evolved, and the shapes and proportional dimensions of the many dams that have been erected in all parts of the world have varied considerably. The fundamental principles on which the design of gravity dams should be based are generally agreed upon but it is in the practical application of those principles that opinions have differed. The author believes that it is possible to design standard profiles which, with comparatively slight modifications, could be adopted to any conditions. The object of the paper is to show that such profiles can be devised and to explain the methods by which their proportions can be determined. The author proceeds to discuss mathematically the stresses in masonry dams and their distribution. He traces the development of theories of stability of masonry dams comprising the work of de Sazilly, Delocre, Rankine, Unwin, Levy, and others. Experimental work with models by a number of investigators in the early part of the present century is also briefly described and results of the experiments are reviewed. The general principles regarding the design of masonry gravity dams are then stated and their application to the design of dams are illustrated. A standard design of a triangular dam 300 ft. high is evolved and diagram showing resultants of stresses on such a dam are given. The method of adopting the triangular profile which is a theoretical one to the bulkhead type in which the pointed upper end of the triangular section is replaced by a rectangular crest is explained and a diagram of stresses in a bulkhead type dam is given. Overflow dams in which the top and the downstream face follow the lines of a curve are treated in the same way and the procedure of arriving at the curvatures is explained. Having arrived at the standard profiles, the author gives a table showing the heights and cross sectional areas of twenty dams built in various parts of the world between 1594 and 1934. The cross sectional areas of the standard dams of the same height are also shown in this table, and the percentage by which the area of the actual dam exceeds or falls short of the area of the standard section is worked out. The profiles of these dams are given in a separate plate. The author concludes that the majority of gravity dams hitherto constructed are unnecessarily massive and considers that the triangular profile modified to suit the bulkhead or overflow type as described in this paper can be used for dams up to 300 ft. high provided that correct proportions are maintained and the dams are constructed of first class materials, founded on solid rock, with proper precautions to prevent leakage under the dam and to provide for internal drainage.

FLOW OF WATER OVER MASONRY WEIRS AND NOTCHES. Garga.

This paper describes work in connection with the calibration of certain falls and discharge sites on the Sarda Canal and presents a critical study of the results obtained. The procedure of taking discharge observations and the instruments used are described. Three types of weir falls were calibrated : falls with narrow flat topped weirs ; falls with broad crested weirs ; and weirs with trapezoidal notches. The calibration of each type is dealt with separately. In each case observed discharges over crests are plotted against actual depths of water observed at site and equations to the lines are obtained by applying the method of least squares. The equations are of the exponential type and give the discharge in terms of the length of crest and depth of water in case of narrow and broad crested weirs, and in terms of the depth of water in case of notched weirs. For narrow flat topped weirs equations have been derived with and without velocity of approach, and the equations are compared to Bazin's equations. Effects of height of crest above bed, of downstream face batter and of the ratio of depth of water over crest to width of crest are discussed, and reference is made to the work of Bazin, Stearn, Merriman and Gibson in this field. Conclusions arrived at from the results of the calibration work are given at the end of the paper. Some of the conclusions are as below:

1. Discharges given by velocity rods are in excess of those obtained by current meters by about 2 per cent.
2. The value of the constant C in the formula for discharge over weirs $Q=CLH^{3/2}$ is not an absolute constant but varies with H.
3. Discharge is increased by flattening the upstream face batter and also by flattening the downstream face batter up to a certain limit.
4. Discharge is reduced if width of the crest is increased.
5. Discharge over a broad crested weir is given by the formula $Q=KLG^{1\cdot5}$ where G is the effective depth of water over the crest and the value of K is in the neighbourhood of 3.00. (See also Quarterly Bulletin No. 2, page 42.)

METHODS OF ECONOMICAL DECK-SLAB DESIGNS. Korni.

This paper gives a new method for the design of reinforced concrete deck slabs based on a recently developed theory which the author calls the Fopple Marcus Theory. The origina theory is due to Dr. Fopple and is too complicated for the average designer but has been simplified to give reasonably accurate results in practice by Dr. Marcus, and has been incoporated in the German Code of Practice. It has been fully dealt with in a paper by Dr. Gehler read before the International Congress for Bridge and Structural Engineering in 1932. The mathematics of the theory is explained and an example of a 20 ft. × 20 ft. slab supported on all sides is worked out to illustrate the method of slab design according to the new theory. The slab is also designed according to Pigeauds' method which is the conventional method and it is shown that the new method effects an economy of 8% in the concrete as compared to the standard method.

COMPRESSIVE STRENGTH OF BRICKWORK, PLAIN AND REINFORCED AND A COMPARATIVE STUDY OF REINFORCED BRICKWORK, REINFORCED BRICKWORK CONCRETE AND REINFORCED CONCRETE. Datta.

The author has conducted many investigations and experimental researches on reinforced brickwork and reinforced concrete, extending over many years from 1916 onwards. In this article he gives the results of some of these experiments concrening strength of plain and reinforced brickwork, and comparative strengths of reinforced brickconcrete and reinforced concerte. Results of experiments on the ultimate compressive strength of brickwork in cement carried out by Mr. Burnett, Superintending Engineer, New Delhi in 1916-17 are also presented. An important result obtained is that while crushing strength of plain bricks is about 1525 lbs. per sq. inch, the strength of a pillar made of single brick placed one over the other is 1132 lbs. per sq. inches and the strength of a compound brick pillar consisting of two or more bricks in each layer is only 600 lbs. per sq. inch. The author discusses the cause of decrease in strength of a compound brick pillar and concludes that the weak point in a brickwork pillar is the adhesion between brick and mortar at the joint which brings about its failure earlier than in the case of the bricks. Hoop reinforcement in pillars rectifies this weakness at the brick joints. From the experiments the author deduces the safe stresses for brickwork, reinforced brick slabs and beams, and brick pillars. The comparative strengths of reinforced brickwork, reinforced brick concrete, and reinforced concrete are discussed with reference to deflexion experiments with beams and slabs of these materials. Stresses developed are also worked out and compared. The experiments show that with low percentage of steel there is not much difference between the load bearing capacity of reinforced brickwork, reinforced brick concrete and reinforced concrete slabs and beams. With high percentages of steel, thin R. B. slabs and beams stand very much higher stresses than deep ones. Finally, the author deduces safe stresses for reinforced brickwork slabs and beams.

In the course of the discussion on this paper, the question of corrosion of reinforcements in R. B. slabs and beams with time was raised. The author in reply stated that recent examination of certain works constructed 17 to 19 years ago shows no evidence of corrosion of reinforcement. He also refers to regulations proposed by him for carrying out reinforced brickwork, and reinforced concrete works which ensures immunity from any corrosive action.

THE MADRAS ENGINEERING COLLEGE MAGAZINE.

Vol. VI.

No. 1.—November 1937.

Some points in the Design of Reinforced Concrete Works. Berry.

This article deals with general principles of design of ordinary reinforced concrete work carried out by local authorities. Theoretical requirements are discussed in co-ordination with practical experience, and recommendations are given with regard to safe working stresses, the placing of reinforcement, cover to rods, and the design of stirrups. The design of simple individual members such as footings, columns, beams, slabs, and small water tanks, is treated in outline.

SCIENCE AND CULTURE.

Vol. 3.

No. 4—October 1937.

MOSCOW—A SEA PORT. **Cotte.**

A general account is given of the Moscow-Volga Canal which has recently been completed. The reasons for constructing the canal, the benefits to be derived from it and the main features of the work are described. (See page 35 of Bulletin No. 6.)

No. 5—November 1937.

ANNUAL REPORT OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, 1936-37.

Editorial review of the report giving brief details of schemes financed by the Council and other activities mentioned in the report. (See page 115 of Quarterly Bulletin No. 7.)

NOTES AND NEWS.

AGRICULTURAL RESEARCH IN INDIA.

Recommendations and suggestions made by Sir John Russell in his report on the the working of the Imperial Council of Agricultural Research are briefly summarized.

SILVER JUBILEE MEETING OF THE INDIAN SCIENCE CONGRESS.

The tour programme of the delegates is given and papers of special interest which are being presented in the different sections are mentioned. List of foreign delegates is also given.

SCIENCE IN INDUSTRY.

STORES DEPARTMENT AND INDIAN INDUSTRIES.

The annual administration report of the Indian Stores Department for 1936-37 is reviewed herein. The inspection branch was entrusted with the inspection of the steelwork of the Meghna Bridge, and the first instalment of material manufactured by Tata Iron and Steel Co., for the new Howrah Bridge. Investigations and researches included tests on clay for Quetta buildings and on cements for the new Howrah Bridge.

No. 6—December 1937.

GOVERNMENT SCIENTIFIC DEPARTMENTS AND LEARNED SOCIETIES.

Fifty years ago modern research was unknown in India. With the spread of Western ideas during the last fifty years a number of Societies and Government research departments have come into being. Short accounts of the more important learned Societies and Government research departments now existing are given herein. The following amongst others are mentioned.

1. Geological Survey of India. The main duty of the Geological Survey of India is the investigation of mineral resources of India, but it is consulted by Central and Local Governments on engineering questions such as preventing landslips, suitable sites for dams and canals with respect to geological structure of the strata, prospects of obtaining underground water, suitability of rocks for buildings and road work, and the construction of earthquake resistant buildings.
2. Indian Meteorological Department. This department supplies forecasts for rainfall and prepares rainfall data for the whole of India.
3. The Survey of India. This department carries out topographical surveys and prepares maps for the whole of India. River and irrigation surveys are undertaken on payment by those concerned and aerial survey work for civil and military purposes is also undertaken.
4. The Institution of Engineers, India.
5. Indian Society of Soil Science. This Society was established in 1935 at Calcutta to cultivate and promote soil science in association with the International Society of Soil Science.

THE FARMER'S WEEKLY.

VOL. XLVIII.

No. 1338—February 6th, 1935.

SAVING ON THE IRRIGATION BILL. **Pels.**

This article gives a general description of researches in California on plant, soil and moisture relationships. The investigations were directed to the study of the behaviour of water in the soil. It was discovered from these investigations that there is a fixed amount of moisture which a given type of soil would hold under any circumstances. The water is held between the soil particles. Investigations on the rate of consumption of water by plants were also made and it was found that the rate of consumption of water bore no relation to the quantity available but was the same whether the moisture content of the soil was high or low. It was also found that a soil would hold a certain percentage of moisture which it would not give up to the plant. This percentage is called the wilting percentage and the amount of moisture over and above the wilting percentage is the readily available moisture. The theory that there is considerable capillary movement through the soil and that as fast as water evaporated from the surface new moisture rose from below to take its place until the entire subsoil was dried out has also been exploded as a result of investigations.

These investigations are likely to throw a new light on the practice of irrigation and will prevent the wasteful practice of over irrigation and other practices based on ideas which have been proved to be wrong by the investigations described.

REVISTA DE LA SOCIEDAD CUBANA DE INGENIEROS.

(In Spanish.)

VOL. XXX.

No. 9—September 1937.

No. 10—October 1937.

Nothing of interest to irrigation engineers in these issues.

CIVIL ENGINEERING (NEW YORK).

VOL. 7.

No. 9—September 1937.

CLOSING THE FORT PECK DAM. Larkin.

"Every large undertaking involves some particularly delicate and crucial operation that may spell success or delay, possiby failure. In the case of the Fort Peck Dam this important feature was the closure of the main dam throwing the river flow through the mammoth diversion tunnels .... Even with the complete preparations for closure so well described in this article, fate intervened in the form of an unexpected slide threatening a vital railroad artery. By shifting the point of attack to the downstream instead of the upstream toe the closure was successfully effected". This article describes the preliminary operations carried out for the closure, the unexpected slide which upset the plans for closure as laid out and the emergency operations by means of which the closure was effected successfully. (See also Bulletin No. 7, page 95.)

THE MORTIMER E. COLLEY BRIDGE. **Millard.**

This steel structure consists of a 300 feet main span formed by two 125 feet deck truss cantilever arms resting on concrete piers and supporting a 50 feet suspended section, and two anchor arm spans at either end of the main span the ends of which are tied down to concrete abutments. This bridge was awarded the first prize by the American Institute of Steel Construction as the finest bridge of its class built in the United States in 1935. It carries a 30 feet wide roadway. The piers are simple pedestals of concrete resting on clay and the abutments are each constructed with six reinforced concrete columns resting on spread footings. Details of design and construction of this bridge are described.

ENGINEERS' NOTEBOOK.

FLOW ON STEEP SLOPES. Hedberg.

The writer emphasizes the fact that flow on steep slopes is distinctly a different problem from that of flat grades. All our hydraulic theory on flow in open channels carries the proviso that flat slopes are assumed. Yet some of the most troublesome problems are encountered in chutes on grades of 10 to 30 per cent. In solving problems of steep flow either it has to be assumed that the theory for flat slopes is sufficiently exact for practical purposes or models have to be built to demonstrate the best design. Observations of flow on steep grades show that in many cases neither of these procedures is reliable. A brief discussion of the forces at work in flow on steep slopes is given and it is shown that the error resulting from the neglect of the slope factor in the velocity and pressure heads is considerable. Model tests are considered unreliable because of the impossibility of simulating the phenomena of the entrainment of air. Quantitative results must therefore not be expected from spillway model tests and only qualitative results are possible.

OUR READERS SAY.

ASPECTS OF FLOOD CONTROL.

Comments on the article "Economic Justification for Flood Protection" published in the May 1937 issue of this journal (see Bulletin No. 6, page 81), are made in two letters. The evaluation of flood losses as a basis for determining the amount to be spent for flood control, and of benefits of flood control measures are further discussed in these letters.

CURRENT PERIODICAL LITERATURE.

Am. Conc. Inst. J. Vol. 8, No. 3, Jan.-Feb. 1937.—"Earthquake Resistance and reinforced concrete" by Creskoff, gives principles of aseismic design in reinforced concrete.

Izvestiya Nauchno-Issledovatelskovo Instituta Hydrotechniki, **No. 19, 1936. Main results of soil consolidation research at Moscow are given. Experimental studies on waterproofing of canal linings with bitumen sand mixes, silicate water glass compound, etc., are described.**

No. 10—October 1937.

COMPENSATORY WORKS FOR ST. CLAIR RIVER.

Pettis.
Moore.

"For a considerable number of years the levels of lakes Michigan and Huron have been progressively lowered by diversions of water and by enlargement of the channels connecting lake Huron with lake Erie .... To restore the former levels, it is proposed to construct a series of submerged sills in the St. Clair River, the outlet of lake Huron.......... Detailed analyses and model studies of the project have been made. Some of the economic and hydraulic factors involved are reviewed in the present article".

To decide upon the most efficient type of sill, experiments were carried out first in a small flume in the hydraulic laboratory of the University of Michigan. Further detailed experiments were made at the U. S. Waterways experiment station at Vicksburg, and the results indicated that sills with vertical upstream faces would secure the maximum efficiency and produced the greatest backwater effect. A model of the upper St. Clair River was built to a horizontal scale of 1 : 100 and a vertical scale of 1 : 30. The model was 180 feet long and the minimum river width was 8 feet. Preliminary tests, however, showed that to reproduce the natural profile, a larger flow was required than that indicated by the similitude relationship. The experiments were made with a larger flow than was theoretically correct and another model was built true to scale, in which the volume of flow and the profile were adjusted satisfactorily to the true similitude relationship. Results obtained from the two models were in agreement and indicated that eight sills with vertical upstream faces would produce the backwarter rise required. All the types of sill which were tested are illustrated. (See also page 95 of Bulletin No. 4.)

SHEAR DEFORMATION INCLUDED IN THREE-MOMENT EQUATION.

Floris.

Lateral earthquake forces can best be transferred to the foundation by means of floor slabs. These concrete slabs are usually continuous over several walls and can therefore be analyzed by the three-moment equation. In its standard form, this equation does not include the influence of shearing forces on the moments over the supports. In a slab subjected to horizontal loads the effect of the shearing forces is appreciable. The purpose of this article is to derive a three-moment equation in which the shearing deformation is included. This equation can be applied in the sme way as the standard three-moment equation and actually the introduction of the shear term facilitates the solution. The author derives the equation and demonstrates its application to a typical problem.

OUR READERS SAY.

STEREOSCOPIC MAPPINIG IN BRAZOS RIVER REGION.

Some further information is presented in this letter in connection with the article on "Air-Mapping the Brazos River Area" published in the July issue of this journal. (See Bulletin No. 7, page 77).

OUTSTANDING FEATURES OF NEW BUILDING CODE FOR NEW YORK.

A summary of the principal features of the new code is given in this article.

CURRENT PERIODICAL LITERATURE.

Am. Conc. Inst. J., Vol. 8, Nos. 3 and 5.—"Study of Subaqueous Concrete" by Anderson. Comparative observations on behaviour of concrete deposited under water are given. Effect of grading of aggregates and fineness of cement on compressive strength is discussed and the best mixture for subaqueous concrete is given.

Am. Conc. Inst. J., Vol. 8, Nos. 3 and 5.—"Portland-Puzzolan Cement as used in Bonneville Spillway Dam" by Clark and Brown. Gives the following information about /Bonneville Spillway Dam: general description, location and foundation conditions, design of dam, cement investigation and selection, special cement specifications, final concrete studies, stress analyses, and construction experience.

Am. Conc. Inst. J., Vol. 8, No. 3.—"Concrete Rehabilitation Work on Uncompahgre Project" by Reeves. Describes condition of 4 miles of concrete lined section of a canal after 30 years of operation, repairing of lining with gunite and construction of new canal lining.

No. 11—November 1937.

SOME ENGINEERING BEGINNINGS. Kirby.

"Although there is basis for the recent claim that engineering did not find a place among the learned professions much before the middle of the eighteenth century, its beginnings go back at least as far as 3000 B. C. Starting in Egypt and Mesopotamia the centre of construction activity later shifted to Rome and its provinces. By the beginning of the Christian era, China's Great Wall, Grand Canal, and certain irrigation systems had already taken form. Construction of bridges and roads continued in China and in the New World came to a climax with the Incas about 1300 A. D. while Western Europe was still in the dark ages. Few records of these early Asiatic and American achievements exist.......... In the accompanying article Professor Kirby sketches high lights in the story of engineering up to about the year 1750".

FLOOD CONTROL IN NEW ENGLAND.

The New England floods of March 1936 focussed attention upon the urgent need for flood protection in that area. The result of studies made by both the Water Resources Committee and the U. S. Engineer Corps were described in three papers delivered before a meeting of the North Eastern Section of the Society held in Boston in May 1937. Abstracts of these papers are presented.

WATER RESOURCES COMMITTEE RECOMMENDATIONS FOR NEW ENGLAND.

Barrows.

This is the first of the three articles and outlines the recommendations of the Water Resources Committee as a whole. The most important aspects of the flood control question in the New England States are the flood control plans for the Connecticut and Merrimack river basins. The Committee's recommendations suggest a group of 37 reservoirs with a total storage capacity of 49 billion cubic feet in the Connecticut basin. The reservoir system is intended to serve the needs of flood control and power generation. For the Merrimack basin 9 reservoirs with a total capacity of 27 billions c. ft. are suggested for flood control and power purposes. The plans of the U. S. Engineer Corps recommend 20 reservoir projects for the Connecticut basin and 5 reservoirs for the Merrimack basin. One third of these are to be of the retarding basin type with outlet conduits and no gates. In addition to these reservoirs, local flood protection by dikes is proposed for important cities in the lower reaches of the rivers. The plans of the U. S. Corps of Engineers however are mainly directed to flood control without taking into account other important water uses such as power and provision for a well regulated increased low-water flow. These aspects are cared for in the plans of the Water Resources Committee.

ARMY ENGINEERS' PLAN FOR CONNECTICUT VALLEY.

Young.

This article describes in some detail the plan of the U. S. Engineer Corps for flood control in Connecticut basin by 20 reservoirs and 7 dykes. Data for the proposed works with probable costs are tabulated, and the computation of direct and indirect losses and benefits are discussed. An instructive comparison is also made of the proposed plan with the Miami Flood Control Project.

ARMY ENGINEERS' PLAN FOR MERRIMACK VALLEY AND PRINCIPAL MAINE RIVERS. Casey.

This article describes the U. S. Corps of Engineers plan of flood protection in the Merrimack basin, which consists of five proposed reservoirs with supplementary river walls and channel improvements. The procedure of flood control surveys in the river basin is briefly described. In connection with selecting the most appropriate method of flood control, the author discusses the use of reforestation, reservoirs, channel improvements, diversions, and levees in flood control. He is of opinion that reforestation measures will not be of material value for flood control in the area in question, and the most desirable method is that by reservoirs, but tremendous storage capacities are necessary. Levees and channel improvement serve their best use as supplementary measures of flood control. Summarizing his conclusion the author states that the best solution for the control of floods in any large river basin will combine a moderate degree of reservoir control with levees in areas where flood damage is concentrated, and with a limited amount of channel improvement at critical places. He then discusses results of investigations in the Merrimack basin and mentions emergency relief work which is being carried out.

THE MANUFACTURE OF STRUCTURAL CLAY PRODUCTS. Emery.

Describes the process of manufacturing glazed and unglazed tile and architectural terra cotta from the pit to the finished product.

GEOLOGY AND CIVIL ENGINEERING. Hotchkiss.

The importance of the science of geology to the civil engineer in dealing with foundation problems is discussed in this article. Important characteristics of some rocks and their origin are reviewed, and difficulties in studying foundation conditions with laboratory examination of samples are discussed. The need for a method of making tests on rocks without removing samples is emphasized.

ENGINEERS' NOTEBOOK.

USE OF REINFORCED BRICKWORK IN LINCOLN TUNNEL BUILDINGS. Dunham.

The walls of the ventilation building of the Lincoln Tunnel are being constructed of brickwork reinforced with steel rods. Details of the work and the circumstances which necessitated the use of this form of construction are described.

FORECASTING RAINFALL BY MEAN SEASONAL DISTRIBUTION. Wenderoth.

A method is described of forecasting rainfall from rainfall data of a station covering a period of years. The use of the method is illustrated by an example.

ENGINEERING AND CONTRACT RECORD.

VOL. 50.

No. 55—January 13, 1937.

FLOOD CONTROL MEASURES ON THE GRAND RIVER. Adams.

The Grand River Valley in south western Ontario is the most thickly populated area in the Province. The river and its tributaries drain an area of highly productive agricultural lands which have been improved by drainage. With the cutting down of forests and draining of swamps, which provided summer storage, the intensity of floods has increased tremendously in recent years. To remedy these conditions it is proposed to construct four impounding reservoirs on the river and its tributaries each with a storage capacity of 10,000 acre feet, and a low dam at the outlet of the river from Luther Marsh. The reservoirs would be formed by dams across the river valley approximately 50 feet high. The locations of the reservoirs, the anticipated reduction of flood levels, the minimum stream flow, and the estimated capital costs are given in tabular form. Nature of the drainage area, and investigations in connection with the proposed project are described, and the bearing of the proposed project on water supply and sewage problems of the drainage area of the river is discussed.

ENGINEERING NEWS-RECORD.

VOL. 119.

No. 10 —September 2, 1937.

CONCRETE PONTOON BRIDGE PLANNED.

A concrete pontoon bridge across lake Washington is being planned and if the plans are adopted, the bridge will be the only one of its type in the world. It will be 8,000 ft. long and will consist of a series of concrete pontoons connected together and anchored to a asunken island at a point where the water is 36 ft. deep.

COMMENT AND DISCUSSION.

BEEM DEFLECTION.

Mr. Troelsch gives a method of determining deflections of a continuous beam. He considers that once the bending moments are known, the deflection of any span of a continuous beam can be obtained by treating the span as a simple span subjected to the continuous beam moments.

EARTH CORE CHEAPENS ROCK BREAKWATER. Gilland.

A detached breakwater now being constructed as a protection for Los Angeles and Long Beach outer harbours consists of an earth core enveloped by a rock fill. Cross sections of the breakwater are given. Originally the breakwater was to be a rockfill structure but material dredged from the harbour to enlarge it was available for the fill and was used with successful results. The equipment and methods of placing the fill are described and the economy of this composite type of construction is discussed.

OVERSEAS ROAD TO KEY WEST. Chamberlin.

Over thirty miles of the railway spanning the Florida Bay are being converted into a modern paved highway. The railway was seriously damaged by a storm in 1935 and the Railway Company was unable to finance the rebuilding of it. It was therefore decided to covert the railway into a highway. About 13 miles of bridge structures are included in the project. The longest bridge is about 7 miles, and consists for the most part of heavy 80 ft. steel girders on concrete piers, but there is a length of about 9,000 ft. of plain concrete 35 ft. span arches. The increased width for the roadway has been provided by welding 25 ft. long steel beams 10 ft. apart, crosswise on the main girders of the old bridges. In the case of the arch spans, the cross beams are set in slots cut in the old concrete arches.

No. 11—September 9, 1937.

UNUSUAL FOUNDATION PLANT FOR LONG BRIDGE.

The Neches River bridge which is being built in Texas is one of the largest in Southern U. S. A. The river is only 1,000 ft. wide at the site but it traverses a wide expense of salt marsh over which the approaches lie, and the total length of the bridge is 7,700 ft. It consists of a 680 ft. cantilever centre span flanked by 374 ft. through-truss anchor spans and deck trusses. The approach spans are shorter and are of the deck girder and concrete slab type. The marsh land on either side of the main stream is incapable of supporting even the construction equipment. Road building across the swamp for carrying the construction equipment was out of the question on account of excessive cost. A channel was therefore dredged through the marsh along the line of approach piers, to provide for floating equipment. In this article the foundation operations are described. The main spans are carried by eight pairs of circular caissons 18 ft. to 32 ft. in diameter sunk about 100 ft. through the mud to hard clay. The approach sapns are supported by low concrete piers resting on untreated wooded piles from 70 to 86 ft. long driven on a batter. An ingenious driving rig developed by the contractor for pile driving is described. The caissons are of heavily reinforced concrete, the walls being 4 ft. to 5 ft. thick and they were driven by the sand island method (see page 36 of Bulletin No. 6), and were sunk by open dredging.

EVAPORATION LOSS IN COVERED RESERVOIRS. Young.

Investigation of evaporation losses from a covered reseroiur were were carried out at La Verne, California. The results are discussed and the conclusion arrived at is that some conservation of water is effected by a reservior cover although not in sufficient quantity if its value be capitalized to pay for the cost of roofing.

DRILLED PILES SEATED IN ROCK SOCKETS.

Foundation work recently completed on a Sanitation Department garage building in New York is described in this article. A feature of the work is the use of large capacity concrete filled steel pipe piles of unusual design. These pipe piles enclose steel columns which are extensions of the building columns of the superstructure. The pipe piles are sunk by drilling through the top soil on to the bed rock. They extend only a short distance into the bed rock. An oversize hole is drilled into the bed rock from the bottom of the pipe piles to form a socket into which the steel columns passing through the pipe piles are extended. This socket is filled with grout and the pipe pile is filled with concrete up to the top. The necessary length of this socket is determined from consideration of bond stress necessary to carry the load not accounted for by direct bearing. The unique characteristic of these " foundation columns " as they are called, is that a considerable portion of the load is delivered to bed rock not by direct bearing on its surface but by bond in the rock which is developed in the rock socket below the pipe pile.

The load capacity of a " foundation column " and the value of the bond developed in the rock socket were determined by means of a special test set-up. The tests and the set-up used are described.

ROAD SOIL BASE BOUND WITH CEMENT. Allen.

A cement stabilized soil base 1 ft. thick was constructed in Kansas U. S. A., in 1936 under a concrete pavement. The soil was silty and very unstable when wet. The construction procedure on this work is described in this article. Briefly, the procedure consisted of spreading cement on the top of the pulverized soil of the road bed at the rate of 5 lb. per square yard per inch of compacted depth and thorough mixing of the cement and the soil; addition of water to the dry mix; and rolling with a sheep's foot roller. Details of the procedure adopted with practical observations on difficulties encountered and improvements needed are given.

BASE PLATE DESIGN FOR BEAM TAKEN ACCOUNT OF DEFLECTION.

Lothers.

In designing base plates to distribute the load from the end of a beam to its masonry support it is customary to consider the load as uniformly distributed over the masonry. The author considers that this assumption is not correct and actual conditions obtained in practice show that the load is not uniformly distributed. He analyses the case of a simply supported uniformly loaded steel beam resting on top of a column having a cross-sectional area equal to that of the base plate and develops a number of equations for the design of the base plate based on his new conception of unequal distribution of load on the column. An example is worked out illustrating the method of design. Lines along which cases with conditions of loading and support can be treated are indicated.

ABUTMENT SETTLEMENT STUDIED BY SOIL MECHANICS.

Grover.

That the principles of soil mechanics can be successfully applied to predict accurately the bearing power of a soil under a superimposed load, has been shown during the course of certain investigations carried out in connection with the settlement of a bridge abutment in Kansas. A study of the subsoil conditions and examination of the soil indicated that the settlement was due to compaction of a 12 ft. stratum of soil with 36 per cent. average moisture content while the liquid limit of this soil was found to be only 33 per cent. The investigations are briefly described and the results are discussed.

NEW USES FOR COTTON TO BE STUDIED.

The Agricultural Adjustment Administration has arranged to provide cotton fabric to various agencies for experimental purposes along certain specified lines. The experiments will include the use of the fabric in the reinforcement of asphalt lined irrigation ditches, stabilizing raw cuts and fills along highways, levees, revetments, and earth dams, the prevention of soil erosion, and reinforcement for road surfaces.

No. 12—September 16, 1937.

THE WEEK'S EVENTS.

WHEELER DAM.

Wheeler Dam, the second of the Tennessee Valley Authority's dams to be completed and placed in service was formally dedicated on September 10, 1937. It impounds a reservoir which carries navigation 74 miles upstream of it to the third dam which is now under construction.

COMMENT AND DISCUSSION.

The Chief Engineer, Pennsylvania Department of Highways gives a full account of the expansion joint failures and repairs on the Westinghouse Bridge at Pittsburgh (See page 101 of Bulletin No. 7). Details of the joints showing existing conditions which resulted in cracking and the proposed method of repair are illustrated.

EXPERIENCE WITH WELLS IN FINE SAND. Archer.

Ten years' experience with the well system of Amarillo, Texas shows that the problem of obtaining a continuous supply of water from fine sand and silt formations has been solved successfully. In these wells open screens are used through which the fine sand is drawn and ejected. The sand drawn out is gradually replaced by gravel introduced at the top of the casing. The details of construction of these wells are given. A study of the conditions of the installation after 10 years' operation reveals that the capacity of the wells has increased tremendously.

CONCRETE WALLS AS COUNTERWEIGHTS.

A unique expedient has been employed to counterbalance the dead loads of the steel arch roofs of two aeroplane hangars built in San Francisco. Two reinforced concrete walls are hung from the two ends of the arch steelwork to act as counterweights. The steel superstructure of the hangars consists essentially of arched trusses with a span of 217 ft. The outer side walls are suspended from a portion of each arched truss extended for this purpose outside the arch supports. By this means, most of the dead load on the trusses was counterbalanced, the stresses in the centre portion of the arches were decreased, and considerable economy in construction costs was effected. Details of the construction are described.

EARTH SHOCKS AT BOULDER DAM.

The revised report of earthquake observations at Boulder Dam shows a total of 13 shocks in the month of June of which one was of intensity V. In some quarters it is apprehended that there might be important displacements in the vicinity of the dam but according to the Director of Coast and Geodetic Survey, earthquakes that do not exceed intensity V are not accompanied by earth movements that can be measured. Comparison of lake level fluctuations with the record of shocks does not indicate that a stationary lake level means an absence of earthquakes. A naturalist sometime ago mentioned indications of the existtence of a natural lake on the site of Lake Mead in comparatively recent geological times. This suggests that the area may now be readjusting itself to a condition of loading that obtained previously.

NON-SHRINKING MORTAR.

A liquid with the trade name of " mortite " has been manufactured which when added in small quantities to brick mortar makes it very workable and permits of a smaller quantity of water being used for the mortar, thus reducing shrinkage. Mortar made with " mortite " does not develop shrinkage cracks and does not separate from the bricks.

No. 13—September 23, 1937.

THE WEEK'S EVENTS.

WPA DAM FAILS AT KANSAS CITY.

An earthfill dam near Kansas city failed by settlement of the downstream side along half its length. The dam was planned to be 84 ft. high and 1,550 ft. long and was nearing completion when the failure occurred. It has a puddle clay core and was constructed of clay placed in 8 inch layers and compacted with sheep's foot rollers. The dam is 550 ft. wide at the base and was about 50 ft. wide at the 80 ft. level to which it had been built. Foundation failure is believed to be responsible for the failure. The foundation material is soft blue shale or clay. Preliminary borings indicated the material to be hard and impervious shale but later on it was found to be much softer than anticipated. A sheetpile cut-off was driven to rock, 50 to 90 ft. below ground level.

WELDING FOR NEW YORK BUILDINGS. Fish.

The new building code for New York city which is to take effect from January 1938 makes full provision for welding structural steel. During the last eleven years several hundred other American cities and towns have given legal recognition to welding. The advantages of welding over rivetting are discussed and the safety and economy of welded construction are emphasized.

No. 14—September 30, 1937.

THE WEEK'S EVENTS.

FOUNDATION OF EARTH DAM FAILS.

A further detailed report of the failure of Marshall Creek Dam in Kansas is given herein. The cause of the settlement of about 700 ft. length of the dam on the downstream side is attributed to the failure of the foundation material to support the weight placed upon it. This portion of the embankment settled 40 to 50 ft. and moved downstream nearly 60 ft. leaving an almost vertical face. A detailed cross section of the dam is given and the method of construction is described. Details of foundation conditions of the site are given and the foundation explorations before the construction are described. The top layer of the sub-soil for about half the width of the valey consisted of loess underlying which there was a layer of blue clay 20 ft. to 30 ft. deep. In preparing the site all surface loam down to the loess was removed. Inspection of the dam after the failure indicated that compaction of the clay was perfect. The slide is under investigation by a board of survey.

SEEPAGE FROM RESERVOIR TRACED TO EARTHQUAKE.

Complaints made by resident in the neighbourhood of San Pedro Concrete reservior in Los Angeles that water was seeping into their basements led to the discovery of a crack in the bottom extending the full length of the reservoir. Test holes drilled round the reservoir showed that the ground was saturated with water. The engineers concluded that the crack was caused by the 1933 earthquake. The bottom contained many small cracks as the concrete was not reinforced. The major crack and all other serious cracks were cut out and filled with concrete. The bottom was then paved with 2 inches of flexible asphalt concrete. Tests after refilling showed only a small amount of leakage.

GROUNDWATER SUPPLIES MENACED IN NEW JERSEY.

Groundwater supplies for the large industrial developments in an area in New Jersey are being depleted rapidly on account of increasing pumpage from the wells. When wells were first driven into the sand bed, which is the source of supply, the water rose 35 to 40 ft. above sea level while in 1935 the water level in some of the wells was as much as 73 ft. below sea level. A report dealing with the investigations has recently been issued by the New Jersey State Water Policy Commission.

BOOK NOTES.

"Applied Fluid Mechanics", by O' Brien and Hickox, 360 pp. $ 3·50. This book discusses recent developments in fluid flow knowledge and illustrates the application of the principles of these recent developments to practical problems. Turbulence, surging, cavitation, and other flow phenomena are described in general terms. A complete elementary derivation of the equations describing the motion of a frictionless fluid is given. Practical applications of fluid mechanics principles to weir, orifice, gate, pipeline, meter, and open channels problems are discussed at length and cover more than half the book. An unusual feature is a chapter devoted to the principles involved in studying open channel flow by geometrically similar and distorted models.

No. 15 -October 7, 1937.

NO MORE FLOODS FOR FITCHBURG.

Fitchburg is an industrial city in Massachusetts and is situated on the North Nashua River which winds through the city. With the development of industries several dams were built on the river for power purposes most of which were abandoned later and fell into disrepair. Plants and buildings encroached on the normal stream channel, and the river became a dumping ground with the result that the waterway was almost completely obstructed in places. The city was seriously flooded in 1936 and a flood control project was taken in hand by the Army Engineers. The basis of design was to provide a channel 80 ft. wide at the bottom with walls or banks at least 13 ft. high. The river improvement programme which is in progress now comprises channel improvements, bank protection, and grading of the river bed on a reach of five miles on the river. Details of the works are described in this article and typical methods and conditions are illustrated. Construction operations are described in detail.

CREST LENGTHS CLASSIFY DISCHARGE. Abbett.

Some interesting results derived from the study of a number of experiments on flow over unsubmerged weirs of different crest lengths are discussed in this article. In making this study eleven sharp-edged rectangular weirs were used ; crest lengths varied from ½ in. to 48 inches and heads ranged from zero to 1 ft. The results of experiments on each weir were expressed by a formula of the type $Q=KLH^n$ and the discharge co-efficient K and the exponent n for each of the eleven weirs were plotted against the crest length. The graphs so obtained indicate that crest lengths between ½in. and 2 inches have a constant value of 1·5 for the exponent n while crest lengths greater than 8 inches have a somewhat lower constant value of 1·465. Separating these two " Constant value " zones is a transition zone in which the value of the exponent varies from 1·465 to 1·5. A universal weir fromula is therefore impossible. It is seen therefore that any attempt to derive an empirical formula for a weir with a constant discharge co-efficient will be restricted to one specific crest length and such a formula applied by direct proportionality to any other length will result in error.

STEEL STRESSES IN CONCRETE PIPE. Gumensky. Whitman.

A series of tests made recently on large reinforced concrete pipes in which the actual strains in the reinforcing steel were measured while the pipe was subjected to combined internal and external loads is described in this article. Many types of specially constructed test pipes 60 inches in diameter were used for the tests. They were constructed and reinforced in different ways. Details of reinforcement in each type are given. The pipe sections were tested in a machine with a pressure capacity of 135,000lbs. Strains in reinforcing steel where measured by a strain gauge. A comparison is made of observed and theoretically computed stresses, and most of the observed stresses are found to be less than computed values. In conclusion the authors give their findings on the design, reinforcements and behaviour of pipes as deduced from analyzing the data collected in this investigation.

WATERWORKS MEN MEET IN MAINE.

The fiftysixth annual convention of the New England Water Works Association was held in September last at Poland Spring Spa. The technical programme consisted of a symposium on pipe corrosion problems and another on gravel packed wells, papers on treatment technique, watershed protection and spillway mode tests. The papers on gravel packed wells dealt with recent installations and operating experiences with such wells in Massachusetts. The importance of thorough tests to insure proper selection of well sites was stressed in connection with a gravel packed well where careful study of draw down curves under various rates of pumping established the limits of the selected area to within a 100 ft. square. Another paper describes how the substitution of a high velocity tube well by a low velocity gravel packed well solved the problem of reducing the iron content of the water to a considerable extent. The paper on spillway model tests gives details of nodel experiments carried out in connection with the design of the spillway for the Bills Brook Dam of the Metropolitan District of Hartford county.

TOLERANCES AND REINFORCING FOR TITLED CYLINDRICAL PIERS. Chambers.

From experience in three recent cases of deep cylindrical pier foundation construction in New York City, the writer proposes a method of reinforcing deep cylindrical caissons which provides for both compression and tension. His contention is that both excessive compression and tension are present in an eccentric pier and both must be provided for.

CARRIAGE FOR SLOPES. Stillman.

Describes a moving platform being used for guniting the soft sand slopes of a reservoir embankment for the Rome, N. Y. water supply. The men work on the platform thus preventing the fine graded earth slope from being trampled. The platform consists of four 12 in. × 12 in. timbers, 50 ft. long, placed parallel to the embankment slope and supported by two cross beams at the top and bottom of the slope. The cross beams are carried by 18 inch wheels which move along the length of the embankment.

No. 16—October 14, 1937.

NEWS OF THE WEEK.

The work of refacing Arrowrock Dam in Idaho is now being carried out by the Bureau of Reclamation. Concrete deterioration on the face of the dam necessitated chipping off a layer and providing a new slab.

THE MOIST CURING OF CONCRETE. Gilkey.

In this article results are presented of an extensive series of tests at Iowa State College on curing carried out with concretes and mortars of many aggregates and gradings from several cements and for test ages up to a maximum of 4 years. In discussing the results the author draws attention to the very great range of strengths that can be developed by specimens cast from a single batch but cured differently or in different moisture states at test. By curing and test condition alone the one year compressive strength may often be made to vary between 45 and and 135 per cent of the standard cured 1 year strength. Curing diagrams are given showing ultimate compressive strengths against age, for specimens subjected to different curing processes. An important observation is that specimens tested dry are 30 per cent stronger than wet tested specimens which is an advangate on the side of safety since design strengths are usually based on wet tested values.

COMPARISON OF RUBY DAM DESIGNS. Jorgensen.

The Ruby Dam is a constant angle arch dam of concrete which is being built on the Skagit River in Washington for the water supply of Seattle. Comparative estimates for a straight gravity dam and a constant angle arch dam were made before finally deciding the type to be built. This article compares the two types from the points of view of economy and safety and shows the superiority of the arch type. The author concludes: "The fact that no arch dam ever has failed indicates the great reserve strength in such structures as compared to gravity dams of which 69 have failed to date, mostly by sliding".

FOUNDATION EXPLORATION IN DEEP WATER. **Dow.**

This article describes the under water exploration work carried out in connection with the Passamaquoddy Tidal Power Project. The project called for the construction of six rock-fill dams across the outlets of Cobscook Bay. The exploration work was undertaken to determine the character and depth of the clay and the underlying rock in the ocean bed where these structures were to be built. Drilling equipment fitted to derrick boats were used for obtaining samples of the clay and the rock. The equipment and operations are described in detail. The project however has since been abandoned.

No. 17- October 21, 1937.

NEWS OF THE WEEK.

PURDUE BUILDS LABORATORY FOR SOIL MECHANICS.

A modern research laboratory of soil mechanics is now under construction at Purdue University. It will embody a number of newly developed devices in soil testing equipment. Its research activities for the first two years will be confined to intensive studies of the consolidation characteristics of clays and to an attempt to develop a more satisfactory apparatus for the determination of shear.

COMMENT AND DISCUSSION.

FAST READING STADIA ROD.

A levelling staff which ensures faster reading and was designed at the Newark College of Engineering some years ago is described and illustrated.

EDITORIAL COMMENTS.

The editor in commenting on the article entitled " Comparison of Ruby Dam Designs " in which the author states that 69 gravity dams have failed while no arch dam has failed, says that the majority of failures occurred in the case of dams built in the days when dam building and designing was based on empirical methods. The failures may therefore more porperly be attributed to shortcomings of engineering knowledge. Arch dams are of recent construction and their design is based on recently developed engineering knowledge.

BAD ROCK LIMITS TVA DAM LOCATION.

Chickamauga Dam on the Tennessee River is being built in an area where no satisfactory foundation rock can be found. Considerations which limited the location of the dam to this particular area are discussed. The foundation conditions were determined by extensive borings. The final site selected contains so many fissures and caverns that proper preparation of foundations has presented some difficult cleaning and grouting problems. These are being solved and it is expected that an entirely watertight and stable foundation will be secured.

ELEMENTS OF CHICKAMAUGA DAM. Warren.

This article contains a general description of the dam. The dam consists of a concrete structure across the main channel comprising a navigation lock, a concrete spillway 960 ft. long and a power house section. The concrete structure is flanked by earth embankments 2,870 ft. and 1,410 ft. long. The spillway is of concrete gravity type 111 ft. high with eighteen gates between 8 ft. thick piers to control the flow. The earth embankments are being constructed of rolled clay. The dam will create a navigable pool extending 59 miles upstream. It will also play an important part in flood control.

BEAM DEFLECTIONS WITHOUT INTEGRATING. Hajnal-Konyi.

The author states that Mohr's theorem can be applied directly to determine deflections of a beam under any condition of support. Complicated integrations are avoided by this method. Three examples are given to illustrate this direct application of Mohr's theorem for the determination of deflections in beams with simple and fixed ends.

CIVIL ENGINEERS MEET WITH CANADIANS.

A joint meeting of the American Society of Civil Engineers with the Engineering Institute of Canada as their guests was held at Boston on October 6-8. In the technical session three papers on difficult construction operations in Canada were presented and there were also several American papers. One of the Canadian papers described the construction of the piers of the Fraser river bridge which is nearing completion. The bridge has a central span of 450 ft. tied arch, continuous with 350 ft. side spans. The main piers resting on sand were built as open caissons in water 30 to 70 ft. deep. Difficulties caused by flood scour are described. In the course of discussion of this paper it was remarked by the President of the Foundation Company of Canada that many millions of money are wasted in carrying piers to rock when they might better be stopped at a higher level as at the Fraser Bridge. He held that flood scour might have been decreased by shaping the caissons elliptically. He considers that vibration in placing concrete should not be used in water exposure as the surface produced is less durable.

The American papers were presented under six of the Society's technical divisions and dealt with soil mechanics and foundations, city planning, pollution of river water, marine borers, and map-

ping. Two of the papers dealing with soil mechanics and foundations namely " Levees in the Lower Mississippi Valley " and " Stability of Embankment Foundations " were published in full in the Proceedings of the American Society of Civil Engineers for September 1937. Prof. Gilboy in a paper presented an excellent general review of soil mechanics knowledge as applied to several specific fields. Among other things he mentions that the view that the position of the line of saturation in earth dams depends on the permeability of the dam and can be kept below the toe is unwarranted as modern experience and soil science show. He also pointed out that the old aim to make dams watertight largely lacks justification.

No. 18—October 28, 1937.

BUCHANAN DAM DEDICATED.

The Buchanan flood control and power Dam on the Colorado River about 40 miles above Austin, Texas was dedicated on October 16. The dam is 11,000 ft. long and 140 ft. high and the reservoir created will impound one million acre ft. of water.

CASPER CANAL PROGRESS.

The Casper Canal of the Kendrick Irrigation Project (formerly known as the Casper-Alcova Project) extends 59 miles from the Alcova Dam on the North Platte River and will irrigate 35,000 acres of land in Casper Wyoming. The Canal is now under construction, and four electric draglines are being used for the excavation work. Nine syphons across drainage channels and six tunnels through ridges are the largest of the 150 structures along the canal. which include culverts, bridges, waste ways and lined canal, sections. This article presents recent results of dragline operation, methods used in driving and lining a typical tunnel through shale, and other information regarding the aggregate being used and mixing plant and procedure. In the lining work of one of the tunnels a special sulphate resistant cement is being used as the water for mixing concrete was found to contain a high percentage of sulphates. In syphons reinforced concrete is being vibrated.

BUILDING IN A BOX.

A two storey mercantile building with exterior walls of glass tile has recently been completed in Milwaukee under unusual conditions. The work was to be rushed through in winter and as glass tile construction could not be carried out in winter conditions, the whole structure was enclosed in a plywood box with a canvas roof. Heat for the enclosure was supplied by steam unit heaters.

UNECONOMIC PUBLIC WORKS.

The economic soundness of a number of large public works undertaken by the Federal Government as employment-producing measures was discussed at the Boston meeting of the American Society of Civil Engineers. Several papers were presented dealing with the economic factors of such projects as the Fort Peck Dam, the Passamaquoddy Tidal Power Project, Grand Coulee Project, Bonneville Project, T. V. A. dams, and the Florida Ship Canal. The authors of the papers found all of the major projects under discussion to be without economic justification and criticized the national administration for withholding from the public many of the reports which clearly showed that the projects could make no return commensurate with the large expenditure on them.

FROM FIELD AND OFFICE.

POND BOTTOMS SEALED BY BENTONITE.

Davis.

Ponds at the Norris fish hatchery which were losing water by bottom seepage have been made tight by the use of bentonite. Three ponds roughly square in shape and covering about 2 acres each were treated. The procedure was as follows. The ponds were drained and allowed to dry, after which the bottom was ploughed to a depth of 8 inches by an ordinary farm plough. After ploughing it was rolled with a sheep's foot roller followed by a drag to remove surface irregularities. The area was then staked in 20 ft. squares and one bag of the material containing 100 lbs. was applied in one square, that is 400 square feet The material used was grade No. 80 KWK Volclay mined and processed at Belle Fourche. The material was spread by hand and this was followed immediately by raking the material into the top 1½ inch of soil. The bottom was then rolled again and dragged to a smooth surface and the pond was filled. It was found that in the three ponds the losses which were 350, 270, 167 gallons respectively in a certain period were reduced to 56, 32 and 17 gallons in the same period.

No. 19—November 4, 1937.

SINKING CAISSONS IN DEBRIS FILL.

The express highway which is being constructed along New York City's Hudson River waterfront has presented some unique foundation problems. The highway consists of elevated steel viaducts for a major part of its total length of about 20 miles. These viaducts are carried on steel caissons and piles which were driven into a filled shore line of buried bulkheads, dumped rock and debris. The work has involved sinking of 353 steel caissons 4 ft. to 10 ft. in diameter, 143 sheeted pits for rectangular piers, and driving, evacuating and filling with concrete over 130 miles of

steel pipe piles. Main features of the work are described, and the difficulties encountered and means adopted to overcome them are mentioned.

King.

CONTRACT DELAYS AND INTERFERENCES. Shields.

This article deals with the legal aspect of engineering contract work. Some decisions of the Court of Claims in cases where contract work was increased in cost by delays of Government agents are given, and practical rules are laid down for the guidance of the contractors whose contracts are unreasonably delayed or interfered with. Various examples of delay and interference which may occur are discussed, with reference to the contractor's position in such cases.

NEW TYPE BRUSH REVETMENT. Trudeau.

A type of brush revetment different in construction from revetments of similar material used on the Mississippi streams has been developed on some of the streams of Western Washington. These streams are comparatively short and carry heavy loads of debris. The revetment consists of rows of stakes parallel to the bank driven at 6 ft. intervals on the river bank previously graded to a slope of 1 in 3. The rows are also 6 ft. apart except for the last two or three rows near the water's edge where spacing is varied to suit conditions. Brush mattresses are then built, first in the water, and then up to the top of the slope. The mattress is tied down to the stakes with wire. The steps involved in placing the revetment are described with illustrations, and costs are discussed. The eventual success of this type of revetment depends on silting up of the mattress, and growth of bank protective vegetation such as willows or berry bushes.

No. 20—November 11, 1937.

BIDS ASKED FOR HIGH DAM AT GRAND COULEE PROJECT.

The Bureau of Reclamation has asked for bids for completion of the Grand Coulee Dam, foundation structures for which are nearing completion. The Dam is to be 4,140 ft. long, and 553 ft. high. An overflow spillway in the central portion will be 1,650 ft. long controlled by eleven floating drum-gates each 135 ft. long and 28 ft. high. An eleven span reinforced concrete bridge will cross the spillway.

COMMENT AND DISCUSSION.

NOT A CONSTANT-ANGLE DAM.

Attention is drawn to certain erroneous statements in the article entitled "Comparison of Ruby Dam Designs" in the October 14 issue of this journal. The dam as being built is not a constant angle arch dam.

MOIST CURING OF CONCRETE.

Certain errors in the tabular statements accompanying the above article published in the October 14 issue of the journal are pointed out by the author.

THIRTY YEARS OF COUNTY-ROAD PROGRESS. Smith.

This article describes road construction practice and organization evolved during the past thirty years in Wayne County, Michigan. Curing of concrete roads, joints, depths of pavements and other features are briefly summarized. The testing laboratory and the work carried out there are described.

BALANCING COSTS IN WINTER CONCRETING. MacBride

In this article a new method is described of finding out the essential points in a winter construction programme which bring about the lowest total cost in forms, cement, construction time, and heat protection methods. It applies to concreting work done in abnormally low temperatures where heating methods and equipment are used for protecting the concrete. An example is given illustrating the use of the method for finding the most economical concrete mix, and heat curing period. Some general conclusions drawn are as follows :—

1. At subnormal air temperatures it pays to maintain concrete temperatures at 70 deg.
2. For air temperatures of 50 deg. or lower, the use of 24-hour cement on light construction work results in saving of time and heat protection costs. For higher temperatures and for mass work ordinary Portland Cement shows a favourable cost comparison.
3. Withl ow time values and milder temperatures a leaner mix and minimum of heat protection will usually show a profit; but as time values increase and temperatures approach freezing it is best to use sufficient heat and a mix which will produce service strength within a short time.

No. 21—November 18, 1937.

THE WEEK'S EVENTS.

Shasta Dam formerly known as Kennett Dam is to be increased in size under the revised plans announced by the Bureau of Reclamation. It will be a concrete gravity structure 3,100 ft. long, and 560 ft. high. It is a part of the Central Valley Project and is to be located on the upper Sacramento River. As originally planned the dam was to be about 500 ft. high.

SEMINOE DAM PROGRESS. Warner.

This article describes progress of operations at the Seminoe Dam of the Kendrick (formerly Casper-Alcova) Project. Diversion of the North Platte River through the recently completed diversion tunnel will enable work on the structure itself to be started. The following items have been fully completed: camp with utilities for 400 men, roads, aggregate and mixer plant, excavation of the horizontal and inclined spillway tunnels diversion tunnel, and the upstream cofferdam. The spillway tunnel consists of an inclined portion at the top followed by a horizontal portion and is 30 ft. in diameter, concrete lined. The diversion tunnel discharges into the spillway tunnel at the junction of the inclined shaft with the horizontal shaft and will be plugged off when the dam is completed. The cofferdam consists of an embankment of sand, gravel, broken rock, and earth with a timber core wall and is 60 ft. high. Brief details of camp building operations, tunnelling work, spillway work, rock excavation work for dam abutments, and construction plant are given.

MAT-VIBRATED CEMENT MACADAM. Pollard.

An unusual construction process is being used in the construction of cement bound macadam pavements at Tecumseh, Nebraska. The cycle of paving operations is as follows: graded stone is spread on the subgrade, sand and cement for the grout are delivered from a mixer on to the stone. After 20 to 30 minutes, a platfrom of slotted mats is placed on the work and gasoline driven vibrators are wheeled over it to compact the penetrated stone and remove excess water and entrained air. The platforms are then removed and surface irregularities are corrected by adding stone chips and grout. The platforms are then replaced and the slab is again vibrated. Finishing is accomplished in the usual way by screeding. The slab produced is of high quality and penetration of the grout to the entire depth of 6 inches is carefully checked. The cement used is ·9 sack per square yard of pavement and the progress is 800 square yard of pavement per day. Expansion joints are formed by creosoted boards 1 inch thick placed at 100 ft. intervals.

No. 22—November 25, 1937.

THE WEEK'S EVENTS.

A view is given of the concrete lined spillway channel of the Earth Dam at Fort Peck. The gate structure consists of 16 vartical lift gates 25 ft. high and capable of passing 250,000 c.ft. per second. Each gate is operated by an individual electric motor and from the control tower one man can lift any two gates or all together. The concrete lined spillway is 1 mile long.

COMMENT AND DISCUSSION.

Mr. Sutherland refers to the Editor's remarks regarding arch and gravity dams in the issue of October 21 and points out that arch dams also were built, based on empirical methods of design, as long ago as 1611. He says that about one quarter of the dams of each type were built in the "empirical" period so that gravity dams are under no disadvantage for comparison. He mentions a number of inherent advantages in the use of arch dams in addition to economy.

DEEP EXCAVATION FOR PARKER DAM.

Uncovering the bedrock for the foundation of the Parker Dam was a unique job because of the unprecedented depth of excavation as compared to the moderate height of the dam above the stream bed. The concrete dam is to be 320 ft. high of which 85 ft. is to be above stream bed, and 235 ft. below the bed of the river. This article describes the work of excavating the foundations, the difficulties encountered in the work and the remedial measures adopted. One of the main difficulties met with was seepage of water into the excavation pit and a battery of centrifugal pumps had to be employed for pumping. As the excavation went deeper more seepage took place and four 26 inch wells were sunk to bed rock, two in the upstream and two in the downstream slopes of the excavation. These were equipped with centrifugal pumps and effectively lowered the level of seepage flow. Two rows of steel sheet piling were driven in the downstream slope of the excavation to hold the ground and control the inflow. The quantity of water pumped increased from 14 cusecs to 37 cusecs by the time the bottom of the excavation was reached. The concreting plant is briefly described and progress for concreting work in the foundations made so far is given. The average rate of placing concrete is 1,700 cubic yds. per day.

FLOOD RUNOFF FROM SMALL AREAS. Cochrane.

"Of the numerous flood-flow formulas that exist, very few are applicable to small drainage areas, and some give values ten to twenty times too small for extreme cases of intense precipitation and quick run-off. For making approximate estimates of flood discharge and comparing one watershed with another it is desirable to have a formula containing all of the principal factors, and applicable to even the smallest areas. The formulas here presented attempt to meet these requirements. They are based on the variation in the rate of precipitation with respect to time, and they give results approximating those obtained by the use of the so-called rational methods."

THE HIGHWAY MAGAZINE.

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JACKING A CORRUGATED CULVERT UNDER A PENNSYLVANIA STATE HIGHWAY. Dyke.

Collapse of a culvert under a highway near Pittsburgh led to an ingenious method of replacing it. A 36-inch corrugated Armco pipe was driven through 200 ft. of fill at a depth of 50 ft. beneath the surface of the road by means of heavy jacks. The equipment, field operations and other features of the work are described, and costs are given.

FLOOD CONTROL IN SOUTHERN KANSAS. Carlson.

Cowskin creek in Kansas has long been a source of damage to farm lands and crops by floods. Flood control measures consisting of widening the creek and construction of levees on the two banks were recently initiated. Brief details of the work are given. Two 7 yard hydraulic scrapers powered with 75 H. P. tractors and a 1½ yd. dragline were used in the excavation.

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PORTLAND-PUZZOLAN CEMENT AS USED IN THE BONNEVILLE SPILLWAY DAM. Clark. Brown.

This dam is being constructed on the Columbia River at Bonneville Oregon. Consideration leading to the decision to use a special type of low heat cement for this dam are discussed with reference to the requirements of the concrete to be placed. Preliminary tests in connection with selection of cement and results obtained are described. Finally as a result of these tests and examinations of mass concrete structures where Portland and Portland-puzzolan cements had been employed it was concluded that tendency towards cracking due to thermal changes was considerably less for the concretes containing Portland-puzzolan cements. Specifications and acceptance tests for Portland-puzzolan cements were evolved and are described, and the characteristics of the cement as purchased are set forth. Laboratory tests made in the course of routine inspection for acceptance are described and results are tabulated. These tests were designed to determine shrinkage of mortars and concrete, temperature rise of adiabatically cured concrete, thermal properties and plastic and elastic properties. Other studies made on the actual work include measurements of temperatures and strains in various blocks, stress analysis, comparison of measured and computed strains, and stresses from final cooling. Construction experience and condition of finished concrete are then described. In the concluding remarks certain conclusions drawn from the use of Portland-puzzolan cements in mass concrete are given and it is recommended that a method of stress analysis in the design of mass concrete dams should be adopted in which the effect of thermal stresses is taken into consideration as well as stresses due to gravity and water loads.

EARTHQUAKES AND REINFORCED-CONCRETE. Creskoff.

This paper deals with the distribution and frequency of destructive earthquakes in U. S. A., the origin of earthquakes, the nature of ground vibrations, their effect on structures, earthquake damage, principles of aseismic design and the characteristics of reinforced concrete which make it particularly suitable for use in earthquake-resistant construction. In conclusion, certain principles which should be observed in the design of earthquake-resistant structures are laid down, and it is mentioned that reinforced concrete is particularly suitable for such structures.

CEMENT AND CONCRETE STUDIES ON THE PASSAMAQUODDY TIDAL POWER PROJECT. Casey.

The proposed Passamaquoddy Tidal Power Project necessitated extensive cement and concrete studies in view of the salt water action, intense freezing and extensive alternate wetting and drying to which the concrete used in the works would be subjected. The results of these studies are reported herein. Finally a modification of Portland cement was proposed for use as a result of the investigations. Specifications of this special cement are given.

CONCRETE REHABILITATION WORK ON THE UNCOMPAHGRE PROJECT. Reeves.

The South Canal is one of the principal works of the Uncompahgre project of the Bureau of Reclamation. It has a capacity of 1,000 cusecs and consists of 6·8 miles of earth channel, 4·06 miles of concrete lined channel, five tunnels and one concrete syphon. The canal was constructed during the years 1906 and 1907. Of the 4·06 miles of concrete lined canal, 500 ft. had side slopes of 2 : 1, 7,000 ft. with side slopes of 1 : 1 and the rest with side slopes of ½ to 1. Approximately one half the lining was reinforced. The lining of the canal in this project failed at many places during the operation of the canal for a period of 25 years after its completion and in 1934 it was decided to carry out a rehabilitation programme of which the repairs to the lining was a part. For the portions with ½ to 1 slopes containing little or no reinforcement, a new lining of reinforced concrete inside the channel was placed, care being taken to secure as much bondage with the old concrete as possible. For repairing the reinforced concrete lining guniting was used. Brief details of the works are given.

DRYING SHRINKAGE OF LARGE CONCRETE MEMBERS. Carlson.

Describes investigations with specimens of concrete and neat cement to determine the volume changes in concrete. The application of diffusion principles to the problem of computing drying shrinkage in members of various sizes is described. The suitability of this method for predicting approximate states of drying is indicated by test data on specimens that have been under observation for 2 years.

A STUDY OF SUB-AQUEOUS CONCRETE. Anderson.

Two methods of depositing concrete under water are now commonly used. One method uses the tremie tube which is a pipe of fairly large diameter and allows the concrete to flow from a hopper above the water surface to the interior of the submerged mass of concrete. The other method employs the drop bottom bucket which is lowered into the water with a load of concrete and when the bottom gates reach the surface under water they release the load.

The objects of the study reported herein were to compare the behaviour of concrete being deposited under water by the two methods, to compare the strengths of the concrete laid by the two methods, and to find the best mixture for sub-aqueous concrete. The methods of investigation are described, results are discussed and conclusions are given. Some of them are as follows :--

1. Tremie concrete was 17 per cent. stronger than concrete placed by the drop bottom bucket.
2. Mixes which would be considered over-sanded for concrete placed in the air give stronger sub-aqueous concrete.
3. The use of finely ground cement in sub-aqueous concrete resulted in marked increase in strength as compared to ordinary Portland cement.

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MEASUREMENT OF DEBRIS-LADEN STREAM FLOW WITH CRITICAL-DEPTH FLUMES. Wilm.
Cotton.
Storey.

Heavy burdens of erosion debris in streams of the San Dimas Experimental Forest in California have been found to cause substantial errors in measurement of discharge at some of the gauging stations where the stream flow is measured with Parshall flumes or V-notch weirs. This was due largely to deposition of debris on the level approach to the throats of the Parshall flumes during low discharge and to the filling of the weir boxes with silt in the case of the V-notch weirs. Experiments were undertaken with the object of adapting the present stations to measurement of flows under all conditions either by improving the debris-transporting characteristics of the Parshall flume or failing this, by developing a control flume that would function satisfactorily under all conditions. It was also intended to test the effect of construction modifications on the rating of Parshall flumes. The experiments were carried out in a specially constructed timber flume below the outlet gates of the San Dimas Flood Control Dam. Details of this flume and of the experimental weir and Parshall flumes constructed in this flume are described. Test procedure is explained and results are discussed in detail. Conclusions are briefly summarised as below :—

1. Construction modifications used in Parshall flumes have a negligible effect on their rating. The results indicate that the Parshall flume gives accurate results for clear, and siltladen flows containing fine material, and is reasonably accurate for measuring large flows with bed-load.
2. Presence of bed-load material substantially influences the ratings of Parshall flumes at low stages of flow, though resulting errors at high flows are small.
3. No alterations introduced into the Parshall flume succeeded in improving its accuracy in small flows with bed-load.
4. A new design of critical depth flume was evolved which appears to give accurate measurements of discharge and to be unaffected by velocity of approach or presence of bed-load. This flume functions as a broad-crested weir, and a general formula for this type has been computed.

Further model studies of this type of flume are in progress with a view to perfecting its design, and results will appear in the closing discussion.

PRE-STRESSED REINFORCED CONCRETE AND ITS POSSIBILITIES FOR BRIDGE CONSTRUCTION. ROSOV.

" This paper contains a brief citation of uses made of pre-stressed steel reinforcement in the past and the development of formulas for the solution of special cases." Basic requirements of the pre-stressed design are discussed. A mathematical treatment of the theory of pre-stressed rectangular beams is given and equations are evolved for the design of such beams. Illustrative examples are given to demonstrate the manner in which pre-stressing can influence the dimensions of a reinforced concrete structure. Tests on pre-stressed reinforced concrete members carried out by E. Freyssinet and others are briefly reviewed and show that the deflections were small and failure occurred at loads much greater than were theoretically computed. Methods of pre-stressing the reinforcement are described. Conclusions regarding the use of pre-stressing of reinforced concrete arrived at by the author are set forth. Some of the important ones are as below :—

1. In using pre-stressed reinforcement, the tensile stresses in concrete are completely cancelled and the compressive stresses that occur over the entire cross section tend to prevent the formation of cracks.
2. Arrangement of reinforcement is simplified because the diagonal tension is appreciably less, and in continuous beams no reinforcement is necessary at the top.

PRACTICAL APPLICATION OF SOIL MECHANICS : A SYMPOSIUM.

The following papers are included : —

LEVEES IN THE LOWER MISSISSIPPI VALLEY. Buchanan.

This paper deals with the general features of design of levees, and the use of the relatively new science of soil mechanics in solving unusual problems arising in connection with levee design. The three essential features to be considered in the design of a levee are the side slopes, foundations, and control of seepage. The slopes in use at present in the Mississippi levees are given and they vary with the material forming the levee. The river side slopes are steeper than the land side slopes. For clay soil, the river side slope is 1 : 3 and the land side slope is 1 : 6. For sand, the river side slope is 1 : 5 and the land side slope is 1 : 8. A method of designing the slope based on the principles of soil mechanics is given. For determining the stability of foundations, the direct shear test or the squeeze test on specimens of undisturbed samples can be used to obtain the ultimate strength of the material *in situ*. The stresses created by levees may be computed by a method described by Jurgenson in the Journal of the Boston Society of Civil Engineers, July, 1934. With these data it is a simple matter to determine the stability of a foundation or the necessary adjustment of design to give a desired factor of safety. Methods employed for the control of seepage are described. Seepage problems involving structures founded on pervious material are analyzed with the aid of models and the data obtained are used to estimate seepage flow and topmost flow line in the actual levee section. Other considerations in the design of a levee unit are, location of levee, source and placement of materials. The nature of the materials plays an important part in the stability of a levee. An outline of the procedure of testing soil material with a view to determine permeability, cohesive strength, liquid and plastic limits, and moisture content is given and an illustrative example of levee design is worked out from a set of assumed basic data which in actual practice are available from soil test and site explorations.

QUABBIN DIKE BUILT BY HYDRAULIC-FILL METHODS. Dore.

The Quabbin Reservoir of the Boston Metropolitan Water District will be formed by a main dam and a dike, both full hydraulic fill structures, the former being 2,640 ft. long and 170 ft. high, and the latter 2,140 ft. long and 135 ft. high: A "full hydraulic fill" earth dam is one built by transporting the material on to the dam in suspension in water, and depositing it in the dam by water, a separation of sizes taking place during deposition. The construction of a hydraulic fill dam is influenced considerably by the rate of consolidation of the core material occuring during and after sluicing operations. This paper describes mainly a method of computing this rate of consolidation developed from data in the case of the Quabbin Dike. This method may be used for estimating core consolidation on a similar project when certain laboratory test data pertaining to the project are available.

Borrow pit material investigations in the case of the Quabbin project are described. The factors to be taken account of and the observations necessary in the control of the deposition of material in the dam are discussed. An equation to determine consolidation during construction is put forward and it is claimed that observations made on the core of the Quabbin Dike indicate the practicability of the use of this equation. The method of use of this equation is explained. The "flow net" method was used to determine the location of flow lines through the dike in order to ascertain its requirements for water-tightness and the dimensions of the core. The locations of flow lines obtained experimentally were subsequently checked by a a laboratory model. The model tests are briefly described. An equation due to Prof. Gilboy and a nomographic chart based thereon for determining the stability of the dike during construction are given and their use explained.

STABILITY OF EMBANKMENT FOUNDATIONS. Hough.

This paper describes certain investigations carried out to study stress distribution in clay foundations, and the character of embankment settlement resulting from foundation stress in connection with two large rock fill embankments proposed as a part of the now abandoned Passamaquoddy Tidal Power Project. The studies relate to a cohesionless uncompacted embankment founded on a relatively uniform cohesive foundation. Foundation explorations carried out to determine the nature of the foundation materials are described. (See also under Engineering News-Record in this Bulletin). The proposed embankments were to be rockfill structures with impervious soil blankets placed on the upstream face. An analysis of stresses created by the structures by the Jurgenson method showed that the stresses created would be greatly in excess of the strength of the foundation material. It was found that to achieve stability, the embankment base width would have to be increased five to ten times. This would be too expensive and so it was considered desirable to investigate the possibility of effecting an economy by building the embankment as originally proposed and allowing failure and displacement of the foundations to take place. To study the extent and character of the settlement to be expected, model studies were undertaken, which are described in detail. The nature of the settlement and the deformation produced were clearly indicated by the models although the results were only qualitative. Further experimentation with the models led to the development of a method of stress analysis before failure and a method of determining the extent of settlement after failure. The details of this analytical method are described in outline and some other available methods are discussed. It is considered that the method developed is more generally applicable than the existing methods. In summarizing his conclusions the author calls attention to the possibility in some instances of effecting economy in embankment design by allowing over-stress of foundations to occur rather than flattening slopes in an effort to prevent over-stress of foundations.

SETTLEMENT OF STRUCTURES IN EUROPE AND METHODS OF OBSERVATIONS.

Terzaghi.

"The methods and results of settlement observations on several structures in Europe selected to illustrate accurately the behaviour of structures on various types of compressible ground are described in this paper. Particular emphasis is given to the observation of settlements of buildings on pile foundations and the comparison between the settlement of individual piles under load tests with that of the entire pile foundation.

The form of settlement diagrams with ground conditions and loading is recommended as a pattern to be followed. The instruments and bench-marks used for settlement observations are described".

The author discusses various aspects of settlement of buildings as revealed by observations and calls attention to the failure to obtain uniform settlements with uniform loading in both pile foundations and spread footings. A statement is included of settlement of bridge piers in Germany in various classes of soil. Settlements ranging from zero to over 3 ft. were observed even though the soil pressures were limited to allowable values.

of

No. 8—October 1937.

THE DESIGN OF ROCK-FILL DAMS. **Galloway.**

This type of dam has been developed in California and other western states during the past 75 years and in recent years some large dams of this type of over 300 ft. height have been built. The rock fill dam is composed of three elements : a loose rock fill forming the mass of the dam ; an impervious face next to the water ; and a rubble cushion between the two. The rock-fill is dumped loosely in position and there is no attempt at orderly arrangement of the individual lumps, nor is there any material introduced to bind them together. The weight of this mass of rock resists the thrust of the water pressure. The design of a rock-fill dam is almost entirely empirical, evolved from practice. It is not the most stable and certain type but under certain conditions specially in remote locations, the cost is usually less than for other types.

The author commences with a short historical sketch of the origin and evolution of the rockfill dam and briefly describes some of the important dams that have been built. He then goes on to describe the elements of design of such dams. The design is based on empirical knowledge gained in the past. The major elements in the design include the foundation, the nature of the rock of which the dam is to be constructed, the dimensions of the loose rock fill, settlement, the impervious facing, the rubble cushion between the facing and the rock-fill and the expansion joints in the facing. Each of the above items is discussed in detail and recommendations are given. Founations should preferably be on solid rock. The materials composing the body of the dam should be hard solid rock which will not disintegrate under weather conditions. The material should be so placed that rock bears against rock. The section of the dam should be such that the base width is more than twice the vertical height. The downstream slope should be at the angle of repose of free falling rock, generally 1·3 to 1 or 1·4 to 1. The recommended slope of the water face is 1·3 to 1. In plan the dam should be some what convex to the water. The rubble cushion between the impervious facing and the rock-fill should have a minimum thickness of 15 ft. and the rubble should be carefully laid. The facing may be of timber, reinforced concrete or steel. In recent dams reinforced concrete has been used, and the thickness of the cushion is 1 per cent. of the height or more. The facing is divided into squares of 50 ft. by expansion and construction joints.

DESIGN OF REINFORCED CONCRETE IN TORSION. **Anderson.**

This paper outlines the various steps in the design of reinforced concrete in torsion. The distribution of torsional moments and torsional shearing stress in a structure are discussed and the design of a reinforced concrete beam in torsion is given.

ECONOMICS OF THE OHIO RIVER IMPROVEMENT. Hall.

" Brief descriptions of the improved Ohio River are given in this paper including methods used in navigating it, and the character of the freight borne upon it. The problem presented is then stated, namely, is the public compensated for the heavy national expenditures on the improvement ? Commercial navigation costs are determined as accurately as possible on a ton-mile basis for each class of freight. Government costs are analyzed on a ton-mile basis applicable to all classes of freight. The sum of these two costs is compared with rail rates, analytically and graphically. The conclusion is reached that the public has been compensated for its expenditures on the Ohio River improvement ".

No. 9—November 1937.

LABORATORY INVESTIGATION OF FLUME TRACTION AND TRANSPORTATION. Chang.

This paper describes a laboratory investigation of the problems of flume traction and transportation. The subject is presented under three main headings. The first part deals with investigations directed to determine the critical tractive force for a series of uniform sands of various sizes, and to study the relation between the variables involved. The second part deals with the study of transportation by traction, and the third part deals with the laws of transportation of material in suspension. The investigations were carried out in a flume 18 ft. long and 1 ft. wide with glassides and brass bottom. The flume with other appurtenant apparatus is illustrated, and the experimental procedure is briefly described. The tractive force investigations are first discussed and an equation has been derived for the critical tractive force in terms of the mechanical properties of the sand. The work of other experimenters is analysed and discussed and it is shown that the results obtained by them conform generally to the critical tractive force equation derived. An equation has also been presented relating Manning's roughness coefficient n with the mean diameter of the grains of the surface layer.

The experiments on transportation by traction are then discussed. An equation is presented giving the rate of sand movement in terms of the tractive force. Formulas given by other authorities including the Schoklitsh bed load formula, Fabre's formula, Meyer Peter's formula, and U. S. Waterways Experiment Station formula are reviewed. The critical tractive force formula is applied to determine the rate of transportation of bed material in a natural stream. In the course of these experiments it was found that coarser material was being dragged or rolled more rapidly than the finer. The cause of this sorting is discussed in mathematical terms.

The final part of the investigations concerns experiments on transportation of material in suspension. Suspension was noticed in the flume in as soon as saltation began. The experimental methods are described. The force required to lift a particle from the bottom of a stream is shown to be proportional to the square of the velocity. A general equation is given for vertical distribution of silt in two dimensional flow. Total silt load in suspension is discussed, and expressions are given for the mean value of silt concentration throughout a depth, and the total quantity of silt transported in suspension per second. The effect of silt transportation on velocity and stream energy is considered and it is concluded that silt transportation tends to decrease the mean velocity of flow. The 'saturation' stage of stream capacity in supporting debris is then discussed and an equation is obtained which states the general relationships that—the graded slope varies directly as the quantity of debris that must be carried, directly as the size of the material, and inversely as the discharge of the stream.

DISCUSSIONS ON THE FOLLOWING PAPERS APPEAR IN ONE OR MORE ISSUES OF THE PROCEEDINGS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS GIVEN ABOVE :—

PRACTICAL APPLICATION OF SOIL MECHANICS: A SYMPOSIUM.

RECLAMATION AS AN AID TO INDUSTRIAL AND AGRICULTURAL BALANCE.

CONSTRUCTION AND TESTING OF HYDRAULIC MODELS, MUSKINGUM WATER-SHED PROJECT.

GRAPHICAL DISTRIBUTION OF VERTICAL PRESSURE BENEATH FOUNDATIONS.

RAINFALL INTENSITIES AND FREQUENCIES.

FLOW CHARACTERISTICS IN ELBOW-DRAFT TUBES.

NATIONAL ASPECTS OF FLOOD CONTROL: A SYMPOSIUM.

THE PASSAGE OF TURBID WATER THROUGH LAKE MEAD.

PROGRESS REPORT OF THE COMMITTEE ON FLOOD PROTECTION DATA.

PRESSURES BENEATH A SPREAD FOUNDATION.

SOIL REACTIONS IN RELATION TO FOUNDATIONS ON PILES.

SELECTION OF MATERIALS FOR ROLLED-FILL EARTH DAMS.

STRESSES AROUND CIRCULAR HOLES IN DAMS AND BUTTRESSES.

EFFECT OF DOWEL-BAR MISALIGNMENT ACROSS CONCRETE PAVEMENT JOINTS.

HYDRAULIC TESTS ON THE SPILLWAY OF THE MADDEN DAM.

ESSENTIAL CONSIDERATIONS IN THE STABILIZATION OF SOIL.

PRE-STRESSED REINFORCED CONCRETE AND ITS POSSIBILITIES FOR BRIDGE CONSTRUCTION.

THE RECLAMATION ERA.

VOL. 27.

No. 9—September 1937.

MEAD LAKE TEMPERATURE MEASUREMENTS. Houk.

Measurements of water temperature at different depths in Mead Lake created by the Boulder Dam have been made at monthly intervals since June 1936. The data show some interesting temperature effects in the various lake strata, particularly near the bottom of the reservoir where abnormally high temperatures are being recorded instead of the minimum temperatures usually observed at such locations. Lake temperatures are measured with an electrical resistance thermometer lowered from a launch. Temperature conditions in the major portion of the lake below a relatively shallow layer near the surface were largely controlled by inflowing Colorado River temperatures. Samples of lake water were taken and examined and it was found that the occurrence of abnormally warm water near the bottom of the lake was due primarily to the presence of a heavy load of suspended silt. Analysis of the samples made at laboratory temperatures showed an increase in specific gravity of the silty water as compared to clear water. Some of the increased temperature effects at the bottom of the lake may be directly due to the flow of the springs, as the spring water in the vicinity of the dam is found to be unusually warm. It is believed that the high temperatures of the water in the lower strata of the lake are primarily due to the arrival of warm silty water of relatively high density which has flowed along the bottom of the canyon beneath the body of the lake.

LARGE IRRIGATION DAM IN MEXICO.

A large storage dam is being built by the Irrigation Commission of Mexico for storing the water of the Nazas River for irrigation purposes. The dam is an earth and rock fill structure 328 ft. high and the storage capacity of the reservoir will be 3,500,000 acre ft.

WYOMING PROJECT RENAMED.

The Casper-Alcova project under construction by the Bureau of Reclamation has been renamed as the Kendrick project. It consists of Alcova Dam on the North Platte River and the Casper Canal which will irrigate 35,000 acres in Casper, Wyoming.

No. 10—October 1937.

PROGRESS AND PROBLEMS OF FEDERAL RECLAMATION. Page.

This is an address delivered by the Commissioner of Reclamation at the annual meeting of the National Reclamation Association. A general account of the progress of the Federal Reclamation programme is given, and some of the most pressing problems, including the financing of reclamation, are discussed. Two types of project are being constructed under the Federal Reclamation. One is designed to rescue developed irrigation tracts from uncertain sources of supply and provide regulated stored water supply for them. The other is designed to expand agriculture on arid lands by providing water for new desert lands. At the present time 12 projects are under construction which will ultimately bring over 2 million acres of new desert lands under cultivation.

GRAND COULEE PROGRESS.

Describes the progress of construction at the Grand Coulee Dam. The greatest single day's concreting at Grand Coulee was 15,600 cubic yards. This has been made possible by the mechanical handling of the materials, of which brief details are given. 30,000 cubic yards of sand and gravel are delivered daily by enormous electric shovels working in gravel pits to a washing and cleaning plant. 40 per cent. of the pit output goes to waste as fine sand and the rest of the processed aggregate is delivered to stock piles by belt conveyors 5,965 ft. long at the rate of 35,000 tons a day. From the streams of sand, cement, gravel and water poured into the mixing plants, automatic scales controlled by electricity and compressed air weigh out in a few seconds the precise quantities of each component to make a 4 yard batch of concrete. Uniform high strength concrete is produced at the rate of a cubic yard in 5 seconds.

GLENDIVE UNIT, BUFFALO RAPIDS PROJECT.

Allotment has been made for the construction of the above project in the Yellowstone River Valley in Montana, U. S. A. The project provides for pumping water from the Yellowstone River for the irrigation of 17,000 acres of land in the river valley into a system of irrigating canals. Construction features include a pumping plant of 250 cubic feet per second capacity, 32 miles of main canal with laterals, priming and puddling of canals, and a drainage system.

PROJECTS IN MINIATURE. Sickle.

The proposed Colorado-Big Thompson Project will divert 300,000 acre ft. of water annually from the headwaters of the Colorado River to Big Thompson, a tributary of the South Platte River, through a 13 mile tunnel, for irrigation of 800,000 acres in north eastern Colorado. It will also develop electrical power. This project met with considerable opposition from the public based on misconception. A true scale model of the Grand Lake area covered by the project was prepared and demonstrated, to convince the public and the Congress of the feasibility of diverting water from the western slope of the Continental Divide to the eastern slope without detriment to the scenic beauty of the Grand Lake and the Rocky Mountain National Park. The model, besides having an educational value, usefully demonstrated the nature of conditions more difficult to describe with maps, and it is expected to be used extensively during the progress of construction. The Bureau of Reclamation may construct a similar model for the Central Valley Project in California.

RETROGRESSION BELOW BOULDER DAM. Corfitzen.

With the closure of Boulder Dam in 1935 the regime of the Colorado River below the dam has been upset and changes are taking place along the river bed as a result of nature's attempt to re-establish equilibrium. Bi-monthly studies of these changes are being made. Before the dam was closed the river discharges varied from 3,000 to 200,000 cusecs and the silt content was high, an average of about 330 tons per minute being carried past a given point. Half of the total silt load carried was finer than ·0025 inch in diameter. The river bed slope was relatively stable, being about 2 ft. per mile. The clear water now flowing out of the reservoir created by Boulder Dam has the capacity to pick up and transport huge quantities of material, and consequently retrogression or removal of the sand and silt of the river bed is taking place. Observations below the dam have disclosed that the fine surface material is first removed but as soon as it becomes scarce the larger particles deeper down are moved. In the two years since the closure of the dam the average size of particles in the 12 miles of river bed below the dam has increased from ·0098 to ·394 inch. At a section 2 miles below the dam the bed has been degraded to a maximum depth of 12·5 ft. The degradation over the first 8 miles, which now appear to be relatively stable, is 6·7 ft. The depth to which the bed has been eroded decreases farther downstream to a point about 50 miles below the dam at which no degradation can be discerned. The point at which retrogression apparently ceases would seem to be the point at which the river has picked up as much load as it can carry, but such is not the case. It has been observed that the river carries three times as much silt in suspension at a point 237 miles downstream as it did when it left the retrogression area This shows that the river picks up fine silt downstream which was not available in the retrogression area. These studies point to the importance of considering retrogression action when planning intakes for irrigation works below a newly constructed dam, or in locating the draft tubes of new power plant.

No. 11—November 1937.

PLANT BEHAVIOR IN DROUGHT. Weed.

Boulder city was built by the Bureau of Reclamation for housing the staff engaged in the construction of Boulder Dam. The town was located in an isolated and barren section of the Nevada Desert. Rainfall in this tract amounts to 3 to 5 inches a year, and temperatures are excessively high during the long summer. The author in his capacity of chief landscape gardener for Boulder city has collected a lot of information on the behaviour and growth of plants, types of plants found suitable, grass planting, irrigation procedure, and suitable fertilizers under arid conditions. In the present articles he presents his experience with planting operations under arid conditions in Boulder city. Shade trees found suitable were the Chinese elm, the popular, the European sycamore and the ash. The best and most prolific plant growth was found to take place in air temperatures of between 50° and 76° F. The cypress was very successful as an ornamental tree. For lawns, a perennial rye grass with Dutch clover was found best suited to local conditions.

THE SHOSHONE CANYON CONDUIT OF THE SHOSHONE IRRIGATION PROJECT, WYOMING. Hosig.

The Shoshone Dam on the Shoshone river forms a reservoir of 456,600 acre ft. capacity which supplies irrigation water to 67,000 acres of irrigable land at distances of 20 to 60 miles from the dam. Water for this area is let into the river at the main dam and diverted to the right and left banks by two diversion dams situated 15 and 20 miles below the main dam respectively. Additional irrigable areas totalling 90,000 acres lie above the present canals, and it is proposed to develop these areas by a high line canal system taking off above the main Shoshone Dam. This high line canal system consists of a tunnel or conduit 14,720 ft. long through the canyon wall at its commencement from the Shoshone Dam. Brief description of the rock formation through which this tunnel is to be driven is given. The tunnel will be a concrete lined horse-shoe section of 12 ft. diameter, with a capacity of 1,200 cusecs. The lower end of the tunnel is the bifurcation point of two supply channels, one for the area on each side of the canyon. One of the supply channels will cross the canyon by means of a syphon.

JOURNAL OF THE COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH (AUSTRALIA).

VOL. 10.

No. 4—November 1937.

Contains nothing of interest to irrigation engineers.

JOURNAL OF THE INSTITUTION OF ENGINEERS, AUSTRALIA.

VOL. 9.

No. 8 –August 1937.

Contains nothing of interest to irrigation engineers.

No. 9- -September 1937.

THE PRINCIPLE OF SIMILARITY – I. **Hart**

" This is part I of a paper which is divided into two instalments. Section A discusses the concepts " identity " and " similarity " in geometry, kinematics, dynamics and thermodynamics. It provides a simple statement in a readily visualized form of the basic principles and their consequences. A tabular statement of the laws of similarity applicable to the four mechanical sciences above is developed."

In recent years, the principle of similarity has become a usual and necessary tool with the engineer and investigator because of the ever increasing use of models in investigations. This paper presents a statement of the underlying principles involved in this idea of similarity and provides some demonstration of objects and processes familiar to the engineer in which the similarity principle can readily be recognized. The ideas presented have sprung from cinematographic studies of hydrodynamic phenomena carried out in a glass channel built for the Charles Kolling Research Laboratory of the Peter Nicol Russell School of Engineering.

DISCUSSIONS AND COMMUNICATIONS.

THE MANNER OF FLOW OF A RIVER IN FLOOD—II.

Comments on the above paper which was published in the May 1936 issue of the journal (See Quarterly Bulletin No. 3, page 59) by two writers and reply to comments by the author.

CONCRETE CONTROL AS USED AT THE MOUNT.

BOLD DAM, SOUTH AUSTRALIA.

A number of writers comment on the above article published in January 1937 issue of the journal (see page 107 of Quarterly Bulletin No. 5).

CURRENT PROBLEMS IN THE USE OF BITUMEN FOR ROAD CONSTRUCTION. **Parkhurst.**

This paper describes the present position in the use of bitumens and asphalts for road construction. The subject is dealt with under six sections as follows :

1. Stabilization of soils.
2. Surfaces for light traffic. Country roads.
3. Surfaces for heavy traffic.
4. Machinery and equipment.
5. Asphalt technology and research.
6. Traffic safety.

Methods of stabilization and surface treatment used in Australia and elsewhere are described in detail. Essentials of of modern asphalt equipment and the trend of present day research in asphalt technology are discussed.

No. 10—October 1937.

THE PRINCIPLE OF SIMILARITY—II. **Hart.**

Continued from previous issue. Deals with similarity parameters in fluid mechanics, and discusses Reynolds' number as the criterion of similarity. The questions as to what Reynolds' number represents and how it governs similarity are discussed in detail. Cinematographic illustrations portraying the functioning of certain of the parameters of fluid mechanics in controlling pattern formation are given.

PUBLICATIONS OF VARIOUS GOVERNMENTS, INSTITUTIONS, SOCIETIES, ETC.

ENGLAND.

Association of Special Libraries and Information Bureaux.

REPORT OF PROCEEDINGS OF THE FOURTEENTH CONFERENCE, 1937.

A record of the proceedings of the Conference held in Cambridge with the papers that were presented. Amongst the papers the following may be mentioned :—

1. Symposium on newspaper indexing.
2. Scientific and technical research in Soviet Russia.
3. The extent to which scientific and technical literature is covered by present abstracting and indexing periodicals.

RUSSIA.

TRANSACTIONS OF THE SCIENTIFIC RESEARCH INSTITUTE OF HYDROTECHNICS, VOL. XVII, 1935.

Contains a number of papers in Russian. Abstracts in English are given of the following papers :—

CONSTRUCTION OF DAMS AND OTHERS STRUCTURES BY DUMPING STONES INTO FLOWING WATER—DESIGN AND PRACTICE. Isbash.

The method of constructing dams and other hydraulic structures by dumping rock into flowing water has been used in a number of structures built in U. S. S. R. during recent years. Two such structures are the cofferdam in the Niva River for the construction of the Niva Hydro-electric plant and a cofferdam for the Lower Svir Hydro-electric plant. The Scientific Research Institute of Hydrotechnics carried out a series of observations and measurements at these two works and the data obtained checked up excellently with the data obtained theoretically by means of the design methods developed by the writer and described in a book entitled " Construction of Weirs by dropping stones in flowing water " published in 1932. The observations at the above mentioned works revealed some additional factors which should be taken into consideration in design. The present paper is in two parts. Part I contains information regarding the development of this method in the U. S. S. R., description of phenomena which take place when rocks is dumped, the basic problem of hydraulic design, analysis of hydrodynamic forces developed, the stability of the stones in the fill, percolation through the fill, details of method of design with graphs facilitating calculations, and methods for computing the shapes of the rock fill. Part II describes construction procedure at the Niva and Svir Hydro-electric plants and gives some additional information obtained from practical experience.

SOME CONSIDERATIONS REGARDING THE LENGTH OF HYDRAULIC JUMP. Chertoussov.

The author analyze some experimental data on hudraulic jump from the works of Bakhmeteff and others and studies a number of empirical formulæ. He proposes a new formula for the length of the hudraulic jump, which shows very good agreement with available experimental data.

FLOW ROUND A CUBE FIXED TO BOTTOM OF FLUME. Goncharov.

The author describes experiments carried out to study forces originated by flowing liquid at the surface of particles having the shape of cubes. Spectrums of forces were obtained placing ninety cubes of the same size made of lead and arranged in different ways around a basic cube equipped with piezometers. The procedure of experiments is described and data are tabulated. The data are analyzed and conclusions are given. The conclusions and formulæ developed indicate the possibility of their application to natural bed load movement.

Transportation of Bedload.

Gavrilenko.

In this paper two questions are considered :-

1. The determination of the relation between the values of Chezy's coefficient C and the roughness coefficient n on the one hand, and the size and other pecularities of bed load on the other.
2. The development of experimental methods for investigation of interrelation of forces between the liquid stream and the bed load.

An equation for steady uniform, slowly variable flow of liquid with bed load in broad rectangular channels has been drived from which two formulæ have been developed for C and n respectively which take into consideration the effect of the bed load. A formula has also been derived for the specific resistance of bed load and all terms in the formula can be measured in the laboratory.

Theoretical Principles of Designing Transit Stream Flows.

Prokofieva.
Novotorzev.

In this paper practical methods are described for plotting transit currents flowing between two solid banks or between two zones of eddies. These methods are based on the theoretical method proposed by Bernadsky for the determination of pictures of flow.

Some considerations upon Steady Slowly Varied Flow of Liquids in Regularly Shaped non-Prismatic Channels.

Weiz.

Integration of the differential equation of non-uniform flow in a non-prismatic channel given in this article permits finite solutions for direct bottom slope, a horizontal bottom, and for a reversed bottom slope. It also contains transformations of the general equation applicable in certain particular cases.

Investigations of Concrete in Structures.

Glujgue.

The main purpose of this paper is the determination of methods by which the behaviour of concrete in structures can be observed. Principal phenomena occuring in mass concrete structures are reviewed as well as methods of their investigation. These include deformation and temperature changes, the composition of a concrete mixture, its permeability, etc., and the determination of modulus of elasticity and co-efficients of thermal expansion and heat transfer in the structure itself. The status of existing methods is reviewed and recommendations are given for further improvement and development of the methods.

ACTION OF THIN SOLUTIONS OF SULPHATES (SIMILAR TO NATURAL WATERS CONTAINING SULPHATES) UPON VARIOUS TYPES OF CEMENTS. Kind.

Describes investigations of the action of week solutions of a number of sulphates, similar to natural waters containing sulphates, on Portland, puzzolana and slag cements. Test data show that weak solutions of all sulphates act upon the cements in the same manner. Samples of Portland cement are however fairly rapidly destroyed while samples from puzzolana and slag cements are not destroyed and harden better than in fresh water.

Other articles, of which translations are not given, are :—

Unsteady wave motion in long pools.

Determination of depth of water cushion.

Considerations regarding the overcooling of water in connection with turbulent flow in open channels.

INDIA.

Central Government.

Home Department.

INDIA IN 1934-35.

This report is issued by the Bureau of Public Information, Government of India for presentation to Parliament. Chapter I of the report deals with agriculture and industry. The section on agriculture gives statistics of area cultivated and the area under the major crops during the year. The net area sown with crops in British India in 1934-35 was 227 million acres of which 50¼ million acres were irrigated. The areas under the various major crops were as follows: Wheat 34·5 million acres; sugarcane 3·47 million acres; cotton 23·83 million acres; and rice 82 million acres. The activities of the Imperial Council of Agricultural Reaserch are briefly reviewed. In the section on Irrigation are given statistics of areas irrigated. The total area irrigated by Government works in 1934-35 was 29·9 million acres or 12·8 per cent. of the area sown. The length of canals increased from 75,000 miles in 1933-34 to 79,000 miles in 1934-35. The area irrigated by the Lloyd Barrage System is given, and important irrigation works completed during the year are mentioned. Irrigation projects under construction are briefly described and include the Nira Canals scheme, the Damodar Canal, and the U. P. State Tube Well Scheme.

In connection with irrigation research, mention is made of the Central Board of Irrigation and its activities.

Copy of a Press note on "the Son Canals of Bihar", 6-10-1937.

This note contains a brief description of the main features of the Son Canals system in Bihar. It is one of the oldest irrigation works in India and was completed in 1891. The system consists of a weir across the river Son at Dehri, 65 miles from its confluence with the Ganges and two short canals taking off from either side which are 21 miles and 7 miles in length. The longer canal has a discharge of 4650 cusecs and the shorter one a discharge of 2350 cusecs. The commanded area is 1½ million acres of which over 1 million acres are cultivable. The tract was subject to frequent famines before the construction of the canals as the rainfall was in adequate and uncertain. The possibility of famine has now been eliminated and there has been an extension of cultivation. The acreage under rice and sugarcane has increased considerably and a local sugar industry has been established.

Some of the difficulties encountered during the early years of the project are described. The canals suffered seriously from immense quantities of sand and silt deposited at the heads. A special fleet of steam dredgers had to be employed to remove 6 million cubic ft. of silt each year. Later, however, as a result of long and careful study of the problem and of experiments conducted at the spot, measures were initiated which have brought the trouble within manageable limits.

Unofficial note on the "Cauvery Mettur Irrigation Project", 7-11-37.

This note describes the main features of the Cauvery Mettur Project in Madras Presidency. The project consists of the Mettur Dam on the River Cauvery about 180 miles from Madras, a new canal 106 miles long taking off from the right bank of the river at the Grand Anicut 130 miles below the dam, and an extension of an old canal. The dam is a huge masonry structure 5300 ft. long, 214 ft. high, 171 ft. wide at the base and 20½ ft. wide at the top. It is three times the size of the Assuan Dam in Egypt. The reservior formed by the dam is 33 miles long and 4½ miles wide at the widest point and covers an area of 60 square miles. The miximum capacity of the reservoir is 95,660 ft., and the water pressure exerted on the face of the dam is estimated to be 6 tons per square foot. The dam is provided with a drainage and inspection gallery 4,000 ft. long which is electrically illuminated. Expansion joints sealed with U shaped copper strips are provided in the masonry. The joints are longitudinal and spaced 126½ ft. apart.

The dam is provided with 4 sets of sluices with electrically operated gates. Modern machinery figured conspicuously in the construction of the dam and included two large concreting towers 306 ft. high, capable of mixing and placing 3,000 c.ft., of concrete a day.

Irrigation in the Cauvery Delta dates back to time immemorial and the Grand Anicut which was built as a solid dam by the ancient inhabitants is the key to the cultivation in the Cauvery Delta. The old irrigation system which was more or less an inundation system was defective and uncertain. The correct solution, a storage reservoir, was propounded by Sir Arthur Cotton a hundred years ago but various schemes were prepared and dropped for one reason or another since that time, until the present project was drawn up and finally approved in 1925. The project, besides providing a dependable supply for irrigation of the Cauvery Delta, will also irrigate a large fertile elevated tract in the south of the Tanjore District which had no means of irrigation from the river owing to its altitude. This new area is estimated to be 301,000 acres.

The project will generate electricity, and will also play an important part in the control of floods in the Cauvery Delta.

UNOFFICIAL NOTE ON "THE LLOYD BARRAGE SYSTEM (SIND)", 26-11-37.

This note describes important features of the Lloyd Barrage Project in Sind which was completed a few years ago. It is one of the most remarkable irrigation works of the World and is already functioning efficiently and providing a livelihood for two thirds of the population of the Province of Sind directly and indirectly The scheme consists of a barrage across the River Indus five times the length of London Bridge, with 7 canals—3 on the right and 4 on the left bank, taking off from it. The barrage is constructed of creamy white limestone with arches of cement concrete and has 66 spans of 60 ft. each, carrying two bridges, one for traffic and the other for operating the gates. The gates are ordinarily operated by electricity though they can be operated by hand also. The canal system is the largest in the world comprising 6,547 miles of channels and 47,773 miles of watercourses. The largest of the 7 canals exceeds the Panama Canal in width at bed level. The total area commanded is 7½ million acres of which 6¼ million acres are cultivable, and 5¼ million acres are expected to be irrigated annually. The total cost of the scheme was slightly under 20 crores of rupees. The net return expected is 3·73 per cent. on the capital outlay 10 years after completion, in 1942-43, and 7·39 per cent. ten years later.

Profit was not the object with which the scheme was undertaken. The main idea was to replace the old precarious system of irrigation with inundation canals by a modern efficient and dependable system. When the scheme is in full operation the area under cultivation will be three times the area cultivated before the construction of the scheme.

The work in itself was of a stupendous nature. The labour employed on the works varied from 30,000 to 50,000 during the working season. For mechanical transport 42 miles of broad gauge and 24 miles of narrow gauge railway track were laid. Other mechanical equipment included 2 dredgers, 2 paddle tugs, and a number of mechanical excavators. 752 crores of cubic ft. of earthwork were done and nearly 2,000 bridges, regulators syphons etc., had to be built. The inhospitable climate with abnormally high temperatures prevailing during the long summer added considerably to the difficulties of carrying on work during the nine years of construction. The work was spread over an area of 12,000 sq. miles a large part of which was desert, notorious for its inaccessibility and lack of water supply. At several places water had to be pumped from the river or old channels to a distance of 4 to 6 miles for construction works and equipment.

The idea of an improved irrigation system in Sind originated soon after the British occupation of the Province in 1843 and various schemes were prepared from time to time until the year 1918 when abnormally low supplies in the river brought about a complete failure of the old inundation canals, and there was very little cultivation, resulting in widespread famine conditions. Conditions threatened to be as bad again in 1920 and the project was expedited and finally approved in 1923.

UNOFFICIAL NOTE ON "THE TANDULA CANAL (CENTRAL PROVINCES)", 12-12-37.

This irrigation Project of the Central Provinces was prepared in 1907 and sanctioned in 1909. Construction began about the middle of the following year and was completed in March 1923 although it has been functioning since 1917-18. The scheme is intended to protect a portion of the Drug district against famine and commands a gross area of about 675,000 acres, of which a little over 600,000 acres, including 216,000 acres of paddy land, are culturable. The scheme is not a paying proposition yet, as arrears of interest are still being paid off. The capital expenditure up to the end of 1935-36 was about Rs. 124 lakhs. The gross receipts for that year were nearly 3 lakhs and the net revenue a little over Rs. 1¾ lakhs.

The scheme comprises a twin reservoir on the Sukha and the Tandula rivers formed by damming the rivers just above their confluence and a canal nearly 69 miles long, with about 523 miles of distributaries. Both the dams are of earthwork and the reservoirs are separated from each other by a rocky spur which has been cut through to connect them, and on which the waste weirs and spill channel are situated. The reservoir on the Sukha is 1½ miles long with a dam 72 ft. high, and that on the Tandula is about 1¼ miles long with a dam 82 ft. high. The reservoirs have a catchment area of 319 sq. miles and are together capable of storing 9,712 million cubic feet of water which is available for irrigation. The canal at its head is capable of discharging nearly 2,200 cusecs.

Department of Commercial Intelligence and Statistics.

AGRICULTURAL STATISTICS OF INDIA, VOL. II, 1934-35.

This is an annual publication of the Government of India which give figures of areas under irrigation, areas under crops, numbers of live stock, and land revenue assessment, in Indian States. Vol. I of the same publication contains similar information for British India (see page 114 of Bulletin No. 6).

The largest area irrigated from all sources during the year was in Hyderabad State while the largest irrigated area from Government Canals was in Bahawalpur State in the Punjab. The total area irrigated by Government Canals in the Indian States during the year was 3,559,000 acres.

Railway Department (Railway Board).

REPORT OF THE INDIAN RAILWAY ENQUIRY COMMITTEE, 1937.

The Indian Railway Enquiry Committee was appointed in October 1936 with Sir Ralph Wedgwood as Chairman to examine the position of Indian State owned Railways and to suggest measures to secure an improvement in net earnings and place railway finances on a sound remunerative basis. This is the full report of the Committee. A summary of conclusions and recommendations is given at the end. The Report contains the following remarks :—

" As we see it the Indian railways are well organised for conducting railway transport with economy, and with operating efficiency; but they are ill organised and ill equipped on what is known as the commercial side—that is, on the side of creating and developing traffic, of securing and maintaining friendly relations with the traders and trading bodies, and of cultivating good public relations generally. We regard this as a serious misfortune, and we hold that the first duty of the Indian railways at the present time is to take every measure possible to remedy this defect ".

" The primary business of a railway is not to spend money nor even to save money but to earn it; and as a means to earning money, it must be free to spend it ".

"The decision to construct a competitive road should rest with the Central Government and the Provincial Governments in consultation, and the responsibility of Agents should be confined to estimating the diminution in railway traffic which it would entail".

"Provinces should draw up a long term programme of road construction and settle in consultation with the Central Government the order of priority in which the works should be undertaken".

"We consider it essential that railways should have full powers, on the same terms as other road users, (*a*) to run road services; (*b*) to invest money in or enter into working agreements with road transport undertakings; and (*c*) to arrange road transport services through contractors".

"We think it regrettable that railways have made no attempt to establish themselves on the roads, and give our reasons for that view".

Department of Education, Health and Lands.

ANNUAL REPORT OF THE PUBLIC HEALTH COMMISSIONER WITH THE GOVERNMENT OF INDIA FOR 1935, VOL. I.

In section I amongst other things, rainfall conditions, and agricultural and economic conditions are discussed. A table of rainfall in inches in each quarter of the year 1935 in various Provinces of India is given. Another table shows the cultivated and uncultivated acreage in the different Provinces for the years 1934-35 and 1935-36.

The section on Public Health works gives details of expenditure on public health works and mentions important works carried out in the various Provinces.

Attention is drawn to the rapid increase in the population of this country which is estimated to reach 400 millions in 1941.

Imperial Council of Agricultural Research.

IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, CONSTITUTION OF THE COUNCIL, RULES AND REGULATIONS OF THE COUNCIL, MEMORANDUM OF ASSOCIATION OF THE COUNCIL, AND BYE-LAWS OF THE COUNCIL.

REPORT ON THE DEVELOPMENT OF THE CATTLE AND DAIRY INDUSTRIES OF INDIA. Wright.

This is a report by Dr. Norman C. Wright, Director, Hannah Dairy Research Institute, Ayrshire, Scotland, who came out to India and toured the country in the capacity of Expert Scientific Adviser (Dairying), to advise the Government on the method and means of developing the cattle and dairy industries of India.

PROCEEDINGS OF THE FIRST MEETING OF THE RICE COMMITTEE APPOINTED BY THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, JANUARY 1937.

In accordance with the recommendations of the Crop Planning Conference held in June 1934, the Imperial Council of Agricultural Research have constituted two standing committees on rice and wheat which will consider all matters pertaining to the productions, marketing and general improvement of the two crops. The proceedings of the first meeting of the Rice Committee are reported herein. Items on the agenda are classified under two heads, research and economics. A research sub-committee was appointed to deal with the research portion of the agenda. Progress reports on rice research schemes, future programmes of work under these schemes and notes by some Governments and members dealing with various aspects of rice research were considered by this sub-committee. Under the economics section the committee discussed amongst other items the necessity of a survey to get reliable information on crop area statistics. It was mentioned that aeroplane photography was capable of providing reliable data expeditiously, specially in areas where accurate village maps do not exist. The committee also discussed the effect on crops of Paris Green used for anti-malarial work. Experiments are in progress in some Provinces to study this problem.

The research sub-committee considered amongst other items a note on the low yield of rice in India and means of increasing it. Another note discussed was on the water requirements of rice for which experiments were in progress in Madras, United Provinces and Bihar. A note by the Sind Government mentions that a large scale " duty " experiment was carried out last year to determine the adequate " duty " of rice cultivation in the Fuleli Canal tract and gave valuable results indicating the actual water requirements of the rice crop during the various stages of growth. A note from the Government of Travancore describes experiments carried out on reclamation of alkali soils by using different kinds of sour leaves such as tamarind etc., for treatment of the soil. The experiments showed that such treatment has a considerable effect in diminishing the alkalinity.

EXTRACTS FROM THE REPORT OF THE BOTANICAL SUB-COMMITTEE HELD AT NEW DELHI ON THE 27TH JANUARY 1937.

This extract gives the decision of the Botanical Sub-Committee on the surveys of plant breeding material. It was decided to collect information regarding the range of variability in all characters of the cotton and rice crop and two small committees for doing the work on rice and cotton respectively were appointed.

EXTRACTS FROM THE PROCEEDINGS OF THE ADVISORY BOARD OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, 28TH JANUARY 1937.

These extracts deal with the action taken by the Advisory Board on the annual progress reports of rice research schemes, future programme of work of such schemes, and effect of Paris Green for anti-malarial work on crops. The recommendations of the Rice Committee regarding these were approved. (See Proceedings of the first meeting of Rice Committee in this Bulletin).

EXTRACTS FROM THE PROCEEDINGS OF THE MEETING OF THE ADVISORY BOARD OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, 28TH JANUARY 1937.

Discussion at the meeting on surveys of plant breeding materials and the recommendation of the Botanical Sub-Committee to start work on rice and cotton.

NOTES PREPARED BY DR. NORMAN C. WRIGHT THE EXPERT SCIENTIFIC ADVISER (DAIRYING) REGARDING THE SCHEMES OF WORK SPECIFICALLY MENTIONED IN HIS TERMS OF REFERENCE AND A NOTE BY COLONEL SIR ARTHUR OLEVER, THE ANIMAL HUSBANDRY EXPERT TO THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, SETTING OUT CERTAIN POINTS ARISING OUT OF THE REPORT BY DR. WRIGHT, FOR THE CONSIDERATION OF THE ADVISORY BOARD OF THE COUNCIL.

These notes deal with animal husbandry.

CHART SHOWING THE PROGRESS OF ACTION TAKEN OF THE RECOMMENDATIONS OF THE RICE COMMITTEE APPOINTED BY THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

One of the recommendations of the Rice Committee arising out of a discussion of a note regarding water requirements of rice was that the Central Board of Irrigation should be approached for any information regarding experimental data on water requirements of rice.

REPORT ON THE WORK OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH IN APPLYING SCIENCE TO CROP PRODUCTION IN INDIA. **Russell.**

One of the conditions laid down when the Imperial Council of Agricultural Research was instituted was that its work should be periodically reviewed by some disinterested expert. Sir John Russell was the first expert to be appointed to report on the work of the Council. The report is in two parts. Part I is a general review of agricultural conditions in India with special reference to the difficult problems associated with the improvement of agriculture and the raising of the standard of life of the cultivator. The work of the Council in this connection is also reviewed and many suggestions are made for improving existing conditions. The crops of India are described and the work done in improving the crops is reviewed. The increase in area under each crop such as sugarcane and cotton is very large compared with the area under food crops. The acreage under rice is apparently declining and sample surveys are recommended in order to obtain definite information on the matter. Factors improving the yields of crops are discussed and recommendations with regard to methods of improving the yields are made. One of the factors which improve the yield is better control of water supply. In discussing irrigation in relation to agriculture Sir John Russell mentions some problems met with. These are the designing of new cropping schemes to permit the best use of the water available, best times for irrigating and optimum quantities to apply. In planning new canal schemes, the proposed croping scheme should be carefully studied because there must be an adjustment of cropping scheme to the available supply to obtain best results. Other problems mentioned are the soil problems in canal irrigated areas, such as waterlogging and alkali problems. He states that it may be laid down as an absolute rule that no irrigation scheme should ever be carried out until a soil survey of the region has been made. All the various problems are being studied at some or other of the research stations and the work is scattered. He therefore strongly recommends the establishment of a central irrigation research station to undertake investigation of all agricultural problems associated with irrigation.

The causes of soil erosion are then discussed and methods of controlling the erosion are mentioned. Better use of manures and fertilizers is necessary for improved agriculture, and manurial trials at the experiment stations need to be more systematic. Special difficulties confronting the Indian agriculturist are described, and possible methods of removing these difficulties are indicated. To deal more effectively with the problems mentioned above the creation of a Development Commission is suggested which would deal with soil conservation, deterioration and erosion, planning of cropping schemes, improvement of grazing land, exploitation of processes of commercial importance, multiplication and distribution of seeds of approved varieties, and improvement of village roads.

Sir John Russell points out very forcibly the necessity for bridging the gap between the research worker and the cultivator. He finds that considerable advance has been made in research in Indian agriculture, but very little use is being made of it by the cultivator, and advocates the concentration of attention on persuading the cultivator by means of demonstrations, or other methods, to adopt the improvements recommended by the Agricultural Departments.

The work of the Imperial Agricultural Research Institute at New Delhi is reviewed and it is suggested that the Institute should take up at an early date work on the method of sampling soils, collection and examination of soil analysis in different parts of India, and experiments on the relative values of nitrogen in green manure, farmyard manure, compost, etc.

Part II of the Report deals with the individual schemes fostered by the Council in various parts of India and sets forth various recommendations for improving the work being carried out It also contains a brief note on the Punjab Irrigation Research Institute, Lahore, visited by Sir John Russell and the different problems being investigated there. It is mentioned that no investigations of the optimum quantities and times of application of water to different crops are carried out though the subject is extremely important. Soil examination methods devised by Dr. Puri are mentioned but it is advised that wherever possible standard methods recommended by the International Society of Soil Science should be used by Indian workers because then only can results be compared with those obtained in other countries and with studies by other soil workers.

A summary of the Report and general recommendations are given at the end.

Imperial Agricultural Research Institute.

SCIENTIFIC REPORTS OF THE IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, NEW DELHI FOR THE YEAR ENDING 30TH JUNE, 1937.

This contains reports of the agricultural research work carried out at New Delhi and Karnal. A review of three decades of research at the Institute which was first situated at Pusa and was shifted to New Delhi in 1936 is given. The work includes crop experiments, manurial trials, rotational experiments, test and design of machinery and implements, breeding improved crops, researches in soil science and agricultural chemistry, water requirements of crops, plant nutrition, bacterial and other diseases of plants, insect pests and control, and the bio-chemistry of crops. Reports by the Imperial Agriculturist, the Imperial Economic Botanist, the Sugarcane Expert, the Imperial Agricultural Chemist, the Imperial Mycologist and the Imperial Entomologist on the work carried out under them at various substations, and the future programmes of work are included.

REPORT OF THE DIRECTOR, IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, NEW DELHI FOR THE YEAR ENDING JUNE 30, 1937.

This is a reprint of the report from the Scientific Reports of the Institute for the year ending June 1937 and deals with the work carried out by the Institute in general, statement of accounts and a review of the work carried out at Pusa and New Delhi during the last 3 decades.

Forest Research Institute.

FOREST IN RELATION TO CLIMATE, WATER CONSERVATION AND EROSION. (EXTRACTS FROM THE PROCEEDINGS OF THE BRITISH EMPIRE FORESTRY CONFERENCE, SOUTH AFRICA, 1935).

This publication contains the report of the Committee on forests in relation to climate, water conservation, and erosion, appointed by the Empire Forestry Conference in South Africa, and the debate on the report and the Conference. A paper on " Soil Erosion in India and its consequences ", by Messrs. Glover and Hamilton presented at the Conference, is also given.

The report of the Committee deals with the effect of forests on temperature, wind, rainfall, humidity, evaporation and climate in general. It is stated that forests exert a moderating influence on extremes of heat and cold and on the adverse effect of winds, increase humidity, retard evaporation, and have generally an ameliorating effect on climatic factors. With regard to rainfall it is pointed out that topographical features of a country exercise a far greater influence upon precipitation than forests alone which have however some influence on the local distribution of rainfall.

The effect of forests on various aspects of water conservation is next considered. The first influence of distruction of forests is on the moisture content of the soil, the diminution of perennial streams, increase of floods, deposit of detritus by wind and water, and gradual reduction of cultivation. Instances are quoted of rivers in India and elsewhere which were previously navigable by sea-going ships but now can be navigated by small boats only. The decay of the great irrigation works of Mesopotamia is due to the neglect of catchment areas of the Euphrates and Tigris. In the case of reservoirs and dams, the influence of forest cover in the catchment areas would be beneficial by decreasing run-off and preventing silting. The silting problem in denuded areas has been causing the greatest anxiety to irrigation engineers. The silt laden water does not penetrate into the soil and causes large floods which run to waste. Forests have a regulating effect on stream flow, decreasing the flood and increasing the flow of water in dry seasons when streams in a denuded area altogether dry up.

The effects of forests on erosion is next discussed. The disastrous effects of erosion following destruction of forest cover are admitted by all authorities.

In the course of the debate, Mr. Trevor, the Inspector General of Forests in India draws attention to the erosion of the outer Himalayas by excessive grazing and cutting down of the forests. Other speakers give their experiences in South Africa and elsewhere.

The article on " Soil Erosion in India and its Consequences " gives a brief account of the topographical features of India, rainfall, and population. The conditions prevailing in the Punjab foothills are then discussed in detail and the causes of the present erosion conditions are set forth. Possible methods of dealing with the erosion problem are indicated.

THE FOOT-HILLS GRAZING PROBLEM IN INDIA. Gorrie.

This pamphlet has been issued by the Imperial Council of Agricultural Research and contains an article reprinted from " Agriculture and Livestock in India ", September 1937 (see Bulletin No. 7, page 54).

Department of Industries and Labour. (Public Works Branch).

REVIEW OF IRRIGATION IN INDIA, FOR THE YEAR 1910-11.

REVIEW OF IRRIGATION IN INDIA, FOR THE YEAR 1911-12.

REVIEW OF IRRIGATION IN INDIA, FOR THE YEAR 1912-13.

REVIEW OF IRRIGATION IN INDIA, FOR THE YEAR 1913-14.

REVIEW OF IRRIGATION IN INDIA, FOR THE YEAR 1914-15.

STATEMENTS SHOWING THE FINANCIAL RESULTS OF PRODUCTIVE AND UNPRODUCTIVE IRRIGATION, NAVIGATION, EMBANKMENT AND DRAINAGE WORKS FOR, AND UP TO THE END OF, THE YEAR 1935-36.

BENGAL.

Department of Agriculture.

ANNUAL REPORT OF THE DEPARTMENT OF AGRICULTURE, BENGAL, FOR THE YEAR 1936-37. PARTS I AND II.

Part I contains reports on administration and works carried out in different sections namely fibre section, chemical section, botanical section, agricultural engineering section, entomological section. Research and experimental works carried out are mentioned. Three methods of mechanical analysis of soils are being experimented upon under instructions from the Imperial Council of Agricultural Research, namely the Truog, the International, and the new Dacca University methods.

Part II contains detailed reports of the heads of the various sections mentioned above together with reports on certain important farms. Research and experiments on rice, sugarcane, jute and cotton are mentioned. Soil work included the comparative study of different methods of soil analysis, and soil surveys of certain areas near the sea which are going out of cultivation due to the appearance of a poisonous substance called Kasch. It has been found that in the affected area plants and vegetable matter in different stages of decomposition are buried under the earth sometimes only three inches below the top soil. This decomposed vegetable matter is supposed to be responsible for the poisonous effect, end possible remedies have been suggested.'

BIHAR AND ORISSA.

Irrigation Department.

ANNUAL ADMINISTRATIVE REPORT FOR IRRIGATION IN BIHAR AND ORISSA FOR THE YEAR 1935-36.

The canal systems in the Province irrigated a total area of 940,248 acres during the year under review as compared with an average of 871,712 acres during the preceding three years. The Son canals which have been classified as a productive work from 1st April 1934, yielded a net return of 5·29 per cent. on the capital during the year. The Orissa canals were worked at a loss of about 7½ lakhs of rupees. On the whole, however, there was a surplus revenue of about Rs. 1,20,000 after meeting working expenses and interest charges during the year. Statements of area irrigated, navigation traffic, financial results, and works expenditure are included.

PROCEEDINGS OF THE COMMITTEE FORMED TO CONSIDER THE MATERIALS COLLECTED BY THE WATERWAYS ENGINEER CONCERNING FLOOD CONDITIONS IN NOTRTH BIHAR, 1937

The Committee was appointed to consider flood conditions in Champaran, Muzaffarpur and Darbhanga Districts in North Bihar, and to suggest measures for flood relief. Three rivers, the Bagmati, Bur Ganadak, and Sikrana are mainly responsible for floods in these tracts. The Committee discussed a number of communications addressed to them by various concerns including the Bihar Planters' Association and the Champaran District Board. The Committee also inspected certain road embankments which are alleged to cause obstruction of flood flows, and certain sections of the Bengal and North Western Railway in which the waterway provided is alleged to be insufficient. A few other localities and existing river embankments were also inspected and after final discussions the Committee came to the following important conclusions with regard to measures for flood relief :—

1. Increasing the waterway in several reaches of the Bengal and North Western Railway line. The afflux at some of the bridges in these reaches was as high as 3′ and 4·5′ ft.
2. Construction of a 20 mile long embankment along the left bank of the Sikrana River.
3. Lowering of certain road embankments and provision of control shutters in some of the large drainage culverts in one road embankment which has recently been raised as a flood embankment.
4. Absolute prohibition of fishing " bands " in any of the Bagmati River channels as they obstruct the formation of a regular channel.

The Committee also reviewed in general the material collected by the Waterways Division which was created in 1934 to collect data on flood conditions. A statement of investigations carried out and proposed by the Waterways Division is attached.

REPORT OF THE MONGHYR (BEGUSARAI) ADVISORY FLOOD COMMITTEE, 1936.

" This Committee was formed to ascertain the causes of severe flooding in the rains of August 1936, in and in the neighbourhood of Begusarai and to suggest any practical relief for the future, of a part or whole of the area flooded."

The flooded tract lies on the left bank of the Ganges and extends up to the railway embankment which runs more or less parallel to the river at a distance varying from 3 miles to six miles from the river. An old " Bandh " or embankment known as the Gupta Bandh which lies on the left bank of the Ganges was 11½ miles long in 1920, but is being cut away by the eroding action of the river so that in 1936, its length was 8 miles. The Committee inspected this bandh and two other roads which were reported to cause obstruction to the flood waters. They came to the conclusion that a retired line of embankment should be constructed from a point on the old Gupta Bandh to the railway embankment which would shut off the town of Begusarai from the flood waters. They also recommend the lowering of two road embankments to ground level as the embankments obstruct the free passage of flood water. They were of opinion that the heavy erosion of the Ganges on the left bank appears to be due to natural causes and not to the works of the Indian General Steam Navigation Company. As a precaution, however, they suggest certain restrictions on the building of jetties and the plying of steamers in the river by the Company.

REPORT OF THE SARAN ADVISORY FLOOD COMMITTEE, 1936.

The Committee was appointed to ascertain the causes of the severe flooding in August 1936, in a large tract of the Saran Distr and to suggest any practical methods of relief for the future. The flooded area consists of a strip of land about 80 miles in length and six miles in width lying on the left bank of the Gogra from its junction with the Chhoti Gandak and the Ganges, and then on the left bank of the Ganges upto the junction of the Gandak and the Ganges. The Committee made a detailed inspection of the flooded area and existing embankments, and came to the conclusion that flooding has been due to the spilling of Chhoti Gandak and the Gogra on their banks. Their principal recommendations are :—

1. Raising two roads, one running along the left bank of Chhoti Gandak, and the other running along the left abank of the Gogra from the mouth of Chhoti Gandak to the confluence of the Gogra and Ganges. The length to be raised in the former is about 2 miles and in the latter about 33 miles. These raised roads will prevent the flood from spilling over the area affected. The raising of the road embankment along the river Gogra, however, may be objected to by the United Provinces Government as the district of Ballia in the United Provinces is on the other side of the Gogra and may be adversely affected by the raising as recommended.
2. Another recommendation is the strengthening of a bundh which runs at right angles to the direction of the river from the confluence of the Gogra and Ganges for a distance of about 5 miles.

REVENUE REPORT OF THE GOVERNMENT OF BIHAR AND ORISSA, IRRIGATION DEPARTMENT, FOR THE YEAR, 1935-36.

Contains a general review of irrigation and navigation works, embankments, and drainage works. Statistical tables showing financial results, areas irrigated, water rates in force, demands and realization, and traffic on canals are given.

UNITED PROVINCES.

Public Works Department. (*Irrigation Branch*).

ADDRESS BY SIR WILLIAM STAMPE, CHIEF ENGINEER, IRRIGATION DEVELOPMENT, U. P., ON THE OCCASION OF THE OPENING CEREMONY OF THE CHITAUAR POWER STATION BY HIS EXCELLENCY THE GOVERNOR OF U. P., ON NOVEMBER 2, 1937. Stampe.

Sir William Stampe's address describes briefly the inimial objects of the Ganges Canal Hydro-electric Grid Project whereby power is developed at a number of falls on the Ganges Canal and is utilized over a large agricultural area. These objects were—the electrification of 88 towns, supply of power for pumping from rivers for irrigation, power for pumping from tube-wells for irrigation, and energizing agricultural machinery in farms. He then goes on to discuss cost of generation and financial return. The total cost of generation is Rs. 1209 per k. w. of which about two thirds represents the cost of a transmission system 4,000 miles in length. Two thirds of the gross output of 29,000 k. w. is allotted for irrigation pumping. Nett return for the current year is estimated at nearly Rs. 4 lakhs. In urban areas current is retailed at fixed rates through licensees who instal their own distribution system. A brief history of the inception of the State Tube Well Scheme is outlined and the operation of the tube-wells is reviewed. 1,490 wells and subsidiary works have been completed at a cost of Rs. 138 lakhs. Further developments possible with cheap power available for the uplift and welfare of the rural tracts are indicated and mention is made of further resources which can ultimately be utilized for power development. Finally, acknowledgment is made of the services of officers connected with the completion of the scheme.

ADDRESS BY SIR WILLIAM STAMPE, CHIEF ENGINEER, IRRIGATION DEVELOPMENT, U. P., ON THE OCCASION OF THE OPENING CEREMONY OF THE UPPER GANGES CANAL FEEDER TUBE WELLS BY HIS EXCELLENCY THE GOVERNOR OF U. P., ON NOVEMBER 2, 1937. Stampe.

Attention is drawn to periodical shortages in supply in the older canal systems. Investigations indicated that cheap power from the Ganges grid could be utilized to pump water from tube wells to supplement the canal supplies in times of shortage. Two projects of an experimental nature were carried out in this connection, in the first of which two distributaries were cut off from the canal and fed by large tube wells. In the second, the tail portion of a distributary was abandoned and replaced by a system of tube wells. Results of these experimental projects are being watched. To supplement the Ganges Canal in times of shortage thirty tube wells pumping 100 cusecs directly into the canal were constructed. The wells are operated during those hours of the day when the hydro-electric system is not otherwise loaded to its maximum output. Cheap surplus current is utilized for supplementary pumping during these hours and the additional water is being utlized for irrigation in the Mat Branch in the districts of Muthra, Agra and Aligarh where construction of tube wells is not feasible for geological reasons. Important experiments are in progress to determine to what extent the water abstracted from tube wells is drawn, in the form of additional seepage, from the canal itself.

THE GANGES CANAL HYDRO-ELECTRIC SCHEME WITH ITS ASSOCIATED STATE TUBE WELL IRRIGATION PROJECT: BRIEF NARRATIVE OF THE HISTORY, OBJECTIVE AND SCOPE OF THE PROJECTS.

Stampe.

The Upper Ganges Canal in the United Provinces commands an area of 4½ million acres and irrigates 1,200,000 acres. It has thirteen falls of 7 to 10 feet of which ten were considered suitable for power development. Features offering economic advantage for a power system developed from this canal system are described. The completion of the permanent headworks of the Ganges Canal in 1920 and of certain remodelling works in 1926, assured a continuous supply on the canal, and investigations of power development projects on a number of falls were undertaken in 1926. The grid scheme was started in 1928, and the stages of its progress are briefly reviewed. The grid scheme was reviewed by an Enquiry Committee in 1934, and another Committee of Experts in 1935, and the conclusions of these committees are given. The grid scheme comprises seven canal power stations supplemented by a steam station as a standby. The four types of transmission lines are described. The capital cost and the cost of production per kilowatt are given. The capital cost per kilowatt installed is Rs. 440 for the hydro-electric installations while the cost for the standby steam installation is Rs. 210 per kilowatt. At the steam station every unit generated costs two pies for coal. Criticisms of the high capital cost and high cost of grid current have frequently been made. These are discussed and their lack of justification is shown. Brief descriptions of the rural distribution system and the State Tube Well System follow and details of the actual development of irrigation and cost per acre are given. Advantages of tube wells apart from irrigation are mentioned. The extent to which these schemes contributed to the relief of unemployment is stated and criticisms as to the purchase of equipment from outside India are disposed of.

CENTRAL PROVINCES.

Department of Agriculture.

REPORT OF DEMONSTRATION WORK CARRIED OUT IN THE EASTERN CIRCLE TOGETHER WITH REPORTS ON THE SEED AND DEMONSTRATION AND CATTLE-BREEDING FARMS OF THE CIRCLE FOR THE YEAR ENDING THE 31ST MARCH, 1936.

The demonstration work included varietal tests of paddy, wheat and sugarcane, manurial tests, and growing of garden crops.

REPORT ON DEMONSTRATION WORK CARRIED OUT IN THE NORTHERN CIRCLE TOGETHER WITH REPORTS ON THE SEED AND DEMONSTRATION AND CATTLE-BREEDING FARMS OF THE CIRCLE FOR THE YEAR ENDING THE 31ST MARCH 1936.

REPORT ON DEMONSTRATION WORK CARRIED OUT IN THE SOUTHERN CIRCLE TOGETHER WITH REPORTS ON THE SEED AND DEMONSTRATION AND CATTLE-BREEDING FARMS OF THE CIRCLE FOR THE YEAR ENDING 31ST MARCH 1936.

PUNJAB.

Public Works Department, (Irrigation Branch).

HISTORY OF THE LOWER CHENAB CANAL HEADWORKS AT KHANKI FOR THE YEAR 1935-36.

Rainfall during the year was abnormal, *i.e.* 34·49″ as compared with 28·59″ last year and 35·29″ during 1933-34, which was the wettest year during the past twelve years.

As regards changes in the course of the river, the right creek has developed into a powerful arm of the river due to the functioning of the right bank undersluices, and this change has been a factor in the improvement of silt conditions in the canal.

The work of reconditioning the Khanki Weir, which was in progress last year, was completed.

The canal continued to be fed on the still pond system of regulation except that the silt ejector tunnels functioned throughout the summer.

Silt conditions in the canal have shown progressive improvement. Factors responsible for this are given.

HISTORY SHEET OF MANGLA HEADWORKS, UPPER JHELUM CANAL, FOR THE YEAR ENDING 31ST MAY 1937.

During the year under review the conditions remained normal and nothing of importance happened. No damage of any kind was done to the works.

HISTORY OF RASUL HEADWORKS, LOWER JHELUM CANAL, FOR THE YEAR 1936-37.

Contains notes on monsoons and floods, damage to works, change of course of Jhelum river and measures taken to remedy this, and the principal works carried out.

HISTORY OF TAJEWALA HEADWORKS, WESTERN JUMNA CANAL, FOR 1936-37.

Contains information on rainfall, floods, canal closures, changes in the course of the river Jumna, and works carried out during the year.

Forest Department.

DASTAN JANGAL.

A pamphlet in Urdu in which the beneficial effects of forests are set forth in the form of a dialogue between a school master and his pupils.

Department of Agriculture.

NOTES, VOL. XVI.

No. 2, October 1937.

This publication is issued twice a year, in April and October, by the Punjab Agricultural Department and is intended to convey to the agriculturists in a simple form useful information and advice on agricultural matters. It is published in English and Urdu and contains brief notes on subjects of interest to agriculturists. The present issue contains the following notes amongst others :—

1. The agricultural year 1936-37 in brief review by the Director of Agriculture, Punjab.
2. The Imperial Agricultural Research Institute, New Delhi by Dr. W. Burns, Agricultural Expert, Imperial Council of Agricultural Research.
3. Soil fertility and the necessity of rotations.
4. The best rotation for cotton.
5. Some common birds injurious to cultivators.
6. Cultivation of American cotton in Punjab Canal Colonies.
7. Manuring of sugarcane.
8. Seasonal hints for planting new gardens.
9. A low lift pump suitable for Punjab conditions.
10. Influence of depth of sowing, soil and season on the germination of cotton seed.
11. Cross 591 as the best wheat variety under irrigated conditions.
12. Amelioration of sandy soils.

The publication also contains a list of leaflets issued by the Punjab Agricultural Department, list of books recommended dealing with agriculture, seed agencies in the Punjab, and price list of various agricultural implements.

Punjab Engineering Congress.

Minutes of Proceedings of the Punjab Engineering Congress, Vol. XXV, 1937.

Contains the following papers with discussions :—

Waterlogging on the Upper Chenab Canal, its Causes and Cure.	B. N. Singh.
Agricultural Economies with Special Reference to Irrigation Problems in the Punjab.	Roberts.
The Raising of Jhelum Bridge.	McIntyre.
The Roads to Kulu.	Johnston.
Turbulent Flow in Channels.	Blench.
A Note on the Building of two Reinforced Concrete Box Culverts on N. W. R.	Kumar.
Some Notes on Gunite and its uses on certain works on the North Western Railway.	Kumar.
The Deg Diversion and the Combined Head Fall and Aqueduct.	Kapur.
The Regulation Gauge for Headless Canal Meters.	Wilson.
Quetta Reconstruction Progress, 1935-36.	Boddington.
Experiments of Premix Work in Mile 35, G. T. Road.	Murari Lal.

For notes on individual papers see Quarterly Bulletin No. 5, pages 121-125.

BOMBAY.

Bombay Engineering Congress.

Minutes of Proceedings of the Bombay Engineering Congress, 1937. Vol. 26.

The following papers are included :—

The Patalganga R. C. C. Bridge at Kharpada.	Sardesai.

This is a reinforced concrete bridge of 9 spans consisting of three central bowstring girder spans of 100 ft. flanked by three reinforced concrete beam and slab spans of 48 ft. on either side. A feature of the bridge is the bowstring girder spans which are of a type patented by Messrs. Christiani and Neilson of Copenhagen. Each span is covered by two bowstring girders with reinforced concrete arch ribs and tie beams with plain 2¼" steel bars as hangers.

The hangars are not vertical but inclined. Three different types of foundations have been used for the piers and abutments, namely, open, cylindrical, and well foundations. The cylindrical foundations are of reinforced concrete cylinders 5″ thick and were sunk on artificial islands made of earth and moorum in the river bed at the sites of piers. This paper gives a brief history of the project, describes the characteristics of the river and considerations leading to the selection of the present site, catchment areas and discharges, loads for design, general design and construction operations. The construction operations are described in detail giving information about supply and quality of materials, pumping and other plant used and foundation construction of piers and abutments. Problems which cropped up during construction and methods adopted to solve them are described.

See also under "Civil Engineering and Public Works Review" of October 1937.

LIME AND CEMENT MORTARS AND THE COST OF "STRENGTH". Graham-Smith.

This paper is the result of an enquiry as to the comparative strengths of lime and cement mortars. The enquirer desired to know if figures were available showing the strength in compression and tension of mortars composed of lime and sand in the usual proportions and of weak mixes of cement and sand, in order to decide whether lime or cement should be used on small works in out of the way places. A series of tests with the available local materials were carried out and the results are given herein. The tests include comparative tests with various mixes of cement-sand and lime-sand mortars, namely, 1 of lime to 1½, 2, 2½ and 3 of sand and 1 of cement to 5, 6, 7, 8, 9, 10 of sand. Subsequently the tests with cement mortars were extended to ratios of 1 cement to 22 sand. Tests were also made on some cement-lime-sand mortars. The materials used and the test procedure are described. Results are given in tabular form. Some general conclusions drawn are :—

1. The rich mix lime mortar is inferior to the lean mix as regards strength.
2. The strength depends on the quantity of water used and not on the amount of lime.
3. The rich cement mortars are very much stronger than the lean ones but even 1 : 22 mortar is stronger than any of the lime mortars.
4. The replacement of cement in a 1 : 2 mortar by an equal quantity of lime resulted in an increase in strength of the mortar.

EARTHQUAKE AND DESIGN OF STRUCTURES. Kynnersley.

The occurrence of several severe earthquakes in India during recent years calls attention to the necessity of studying earthquake phenomena with a view to avoid the apallin tragedies of the past. The author discusses general causes of earthquakes, seismic conditions and zones in India, manifestations and interesting features of earthquakes, and measurement of earthquake intensities. He then passes on to the design and planning of buildings of the earthquake-resistant type. General considerations for selecting sites for towns in localities subject to earthquakes are discussed. Planning of buildings, and the proper type of foundations are described. An ideal foundation is a reinforced concrete mat. For foundations on soft ground a special type of foundations known as the Salvus foundation is recommended. The salient features of this type of foundation are described and illustrated. General principles of superstructure design are mentioned. The superstructure may either be flexible or rigid, though the majority of engineers now favour the latter type. Reinforced concrete walls are the most reliable construction for earthquake proof buildings. For floors, reinforced concrete is virtually a necessity. Roof structures should be light, and tiled roofs should be prohibited. Recommendations and general instructions for other structural parts such as doors and windows, staircases, etc., are given. A brief note on building materials used in the construction of earthquake proof buildings, and extracts from building codes concerning such buildings in force in different countries are given.

SIND.

Public Works Department (Irrigation).

INDUS RIVER COMMISSION RECORDS, 1935-36. VOL. II, PART I—RIVER COURSE PLANS.

INDUS RIVER COMMISSION RECORDS, 1936-37. VOL. II, PART I—RIVER COURSE PLANS.

REPORT ON EXPERIMENTS WITH A MODEL OF A REGULATOR OVER 28TH MILE BEGARI CANAL, CARRIED OUT IN THE DEVELOPMENT AND RESEARCH DIVISION AT THE KARACHI TESTING STATION. Technical Paper No. 2, 1937. Bushby.
Hiranandani.

The model experiments described herein were undertaken to determine the best and cheapest mode of dealing with scour below regulators. In this particular regulator which was originally a road bridge and later converted to a regulator, a scour hole 23 ft. deep was formed. A model 1/24 full size was constructed and tests were carried out with needles and wales, and with vertical screw gates. Eighty four experiments were performed with various types of structures for preventing scour. The final design adopted consisted of 3 rows of staggered blocks mounted on baffles, and a deflector. The conclusions drawn are :—

1. The optimum height of staggered blocks mounted on baffles required to give satsifactory results without producing scour was 1/5 depth of water on the downstream.
2. Friction blocks used in the Punjab did not give satisfactory results.
3. An overlap of ½″ on either side of the blocks (equivalent to 1 ft. on the prototype), mounted on baffles, which created 3 cisterns above the pavement, were effective in reducing bed velocities.

NOTE ON THE POSITION IN THE BARRAGE COMMAND AS WELL AS BEGARI AND SHIKARPUR INVESTIGATED AREAS IN REAGRD TO CHANGES IN THE LEVELS OF OF THE SUB-SOIL WATER TABLE WHICH HAVE TAKEN PLACE BETWEEN APRIL 1936 AND APRIL 1937.

Plans showing Hydro-Isobaths and difference contours for the whole of the Barrage Command, the Khairpur State, and Shikarpur and Begari areas are included and causes of the rise or fall of water table as indicated by the plans are discussed.

SIND RIGHT BANK DRAINAGE PROJECT, VOL. I : GENERAL REPORT ON THE PROPOSED DRAINAGE PROJECT FOR THE RIGHT BANK.

This drainage project has been prepared for the tract on the right bank of the River Indus in Sind bounded by the North Western Canal and the Khirtar Branch on the north, the Indus River in the east and the Khirtar Range on the west. A very large part of this area has a high subsoil water table and the principal cultivation is rice. In view of the danger of serious permanent rise in the water table in this area after the commencement of barrage irrigation the present drainage project was prepared. This report describes important features of the right bank tract, investigations leading to the preparation of the project, general features of the project, methods of fixing alignments of drains and feeders, design of drains, and design of masonry works. Plans and estimates of the works are also included. Certain conclusions arrived at as a result of field and other investigations are given. The most important of these is that there does not appear to be any necessity of taking up the construction of drainage works on a large scale in view of the general satisfactory condition of subsoil water table at the present time. The limitations of the drainage project are discussed. The strict control of irrigation supplies will obviate the necessity of construction of drainage works on a large scale.

Memorandum of Instructions for the River Discharge Observers in Sind, 1936. (Second Edition).

Detailed instructions are given for selecting the site at which discharge should be measured, use of the discharge boat equipment, use and care of current meters (Gurley and Haskell), use of mason's level, etc. Correct method of computing discharge is described. Instructions regarding silt observations are also included.

Weekly Statements showing Rabi Cultivation areas up to 4th December 1937 in Sind as compared with those obtained up to the corresponding date last year.

MADRAS.

Department of Agriculture.

The Earth Scope. Leaflet No. 78. Charley.

Describes an implement for the levelling of fields, excavation or cleaning out of drains and channels, and in general for any job involving the movement of soil over short distances. It is operated by bullocks. The method of its use, rate of working and prices are given.

Preparation of Turmeric for Market. Leaflet No. 80. Charley.

A new polishing machine for turmeric is described herein.

INDIAN STATES.

Mysore State.

Department of Agriculture.

Administration Report of the Agricultural Department for 1935-36 with the Government Review thereon.

Contains the reports of the Director and Assistant Directors in charge of the various circles on the work carried out and reports of Experts in charge of the various sections, chemical, mycological, entomological, etc. Reports on certain important farms are also included.

BURMA.

Department of Agriculture.

REPORT ON THE OPERATIONS OF THE DEPARTMENT OF AGRICULTURE, BURMA, FOR THE YEAR ENDED THE 31ST MARCH 1937.

Contains a summary of the work done during the year followed by detailed reports of officers in charge of various sections and circles. Rice research is under a separate officer and investigations on rice include : —

(1) Investigations of the effect of soil and climatic conditions on quality of rice.

(2) Investigations of effects of different dates of harvesting on the quality of rice.

AFRICA.

British East African Meteorological Service.

BULLETINS OF DAILY RAINFALL IN TANGANYIKA TERRITORY FOR THE MONTHS OF JANUARY TO DECEMBER 1936.

SUMMARY OF RAINFALL IN TANGANYIKA TERRITORY FOR THE YEAR 1936.

BULLETINS OF DAILY RAINFALL IN UGANDA PROTECTORATE FOR THE MONTHS OF JANUARY TO DECEMBER 1936.

SUMMARY OF RAINFALL IN UGANDA PROTECTORATE FOR THE YEAR 1936.

BULLETINS OF DAILY RAINFALL IN KENYA COLONY FOR THE MONTHS OF JANUARY TO DECEMBER 1936.

SUMMARY OF RAINFALL IN KENYA COLONY FOR THE YEAR 1936.

UNITED STATES OF AMERICA.

Department of Agriculture.

FLOW OF WATER IN DRAINAGE CHANNELS : THE RESULTS OF EXPERIMENTS TO DETERMINE THE ROUGHNESS COEFFICIENT IN KUTTER'S FORMULA. Technical Bulletin No. 129, November 1929. **Ramser.**

Kutter's formula is generally accepted by engineers as being the most satisfactory formula in use for computing the flow of water in open channels. The results obtained by the use of this formula

are however affected to such a degree by the coefficient of roughness that the selection of the correct value for this factor is a matter of the highest importance. The series of experiments described and summarized in this bulletin were undertaken for the purpose of determining appropriate values of the coefficient of roughness for various conditions of channel. The experiments were conducted on existing channels in nine different localities. Field measurement procedure comprising the measuremet of discharge, water surface slope, and cross sections is described and the method of computing the value of *n* is explained. The nine sets of experiments are described in detail and results are presented in tabulated form. The results of each experiment are discussed in some detail and conclusions arrived at from a study of the results are set forth at the end. A table is also given showing recommended values of *n* for various types of channels to be used for designing purposes.

Department of the Interior, Bureau of Reclamation.

DETERMINATION OF NON-LINEAR STRESS DISTRIBUTION IN BOULDER DAM BY RUBBER SLAB EXPERIMENTS. Technical Memorandum No. 442, March 4, 1935. Waldorf.

This publication describes experimental investigations of stresses in the Boulder Dam by what is called the method of analogy. In this method a rubber slab of the same profile as the section of the dam to be investigated, reduced to an appropriate scale, is deflected artificially to a particular shape. Stresses in the original structure are then analogous to curvatures in the rubber slab. The method is based on the fact that the equation governing the distribution of stress in the two dimensional case has the same form as the equation governing the reflections of a rubber model, both being differential equations of the foruth order. Any system of curvatures and twists made possible in a rubber slab by deformation of the boundary will therefore be analogous to a distribution of stress in a plane solid of the same shape distorted by loads applied to the edge. To solve a plane stress problem by means of a rubber slab it is sufficient to apply to the boundary of the slab similar in shape to the original, curvatures proportional at every point of the boundary to the loading on the original. The sections, investigated are the crown cantilever section, and the horizontal arch section at elevation 900 of the Boulder Dam. A detailed mathematical discussion of the theory of the problem with mathematical computations necessary for the experiments, is given, followed by a description of the equipment used in the investigations and the general procedure of the tests. Results of the tests are discussed and the conclusions arrived at are as follows. The tests show that the rubber slab method gives reasonable results as compared to other methods and is a valuable auxiliary in rapidly determining stresses in small areas or at check points. The results of the tests show that a linear distribution of stress exists throughout the greater part of the cantilever.

CALCULATION OF STRESS DATA FROM STRAIN MEASUREMENTS. Technical Memorandum No. 542, December 14, 1936. Bergman.

This report explains a method for computing the surface stresses in a body subjected to two or three dimensional stress, from strain gauge readings taken on three or more intersecting gauge lines. The method was developed in connection with the analysis of tests of models of Boulder Dam made by the Bureau of Reclamation in the Civil Engineering Laboratories of the University of Colorado.

NOMOGRAPHIC DETERMINATION OF BOUNDARY STRESSES IN GRAVITY DAMS. Technical Memorandum No. 547, March 15, 1937. Soehrens. Moody. Brahtz.

A series of thirteen diagrams are presented herein, each of which is a graphical representation of a stress formula or combination of formulas. Diagrams 1 to 5 give the maximum and minimum stresses that can occur on the faces for various loading conditions which include the action of the dead load, water load, uplift, horizontal earthquake of intensity of one-tenth gravity and vertical earthquake of intensity of one-tenth gravity. Diagrams 6, 7 and 8 give the magnitudes of dead load, water load and horizontal and vertical earthquake effect individually. Diagram 9 gives the stresses produced by a parabolic water load surcharge developed during an earthquake. Diagrams 10, 11, 12 and 13 give the effects of a change in water surface and crest conditions in general. The application and use of the diagrams are demonstrated by working out a typical example for each one. A resume of stress formulas used in preparing the diagrams is given. The magnitudes of the principal stresses alone and parallel to the faces of a gravity dam furnish a measure of its stability in a manner satisfactory for preliminary design. With the use of the diagrams a section can be obtained which upon later detailed analysis will be found to fit specified requirements closely.

ANALYSIS OF A CIRCULAR ARCH UNDER UNIFORM LOAD. Technical Memorandum No. 550, April 29, 1937. Houck.

The purpose of this memorandum is to develop equations for the radial deflection at the crown due to uniform radial load, and radial deflection at the crown due to temperature of an arch of uniform thickness with radial abutments. The forces and moments due to elastic yield of the abutments are also considered. From the equations derived curves for constants occuring therein have been plotted and provide a rapid and simple means of determining radial deflexions at the crown.

PROCEDURE FOR MAKING TEMPERATURE STUDIES ON EXPOSED SLABS. Technical Memorandum No. 551, May 7, 1937. — Culver.

This publication presents a few formulæ and curves concerned with temperature variations in a concrete structure and explains their use in practice. Methods for making temperature studies on explosed slabs are given, and an explanation is given as to which methods should be used to solve a specific problem. Data to be collected and tabulated for temperature studies, are given for general and specific cases. Formulæ and calculations are given for finding the temperature at the centre of a block of concrete a given period after the placing thereof, temperature gradient across a block of concrete, isotherms for a number of blocks, time temperature curve, time required for a structure to lose a certain percentage of heat of setting, and the ratio of concrete temperature to exterior temperature.

A STUDY OF THE DETERIORATION OF RIGID METAL ELECTRICAL CONDUIT WHEN EXPOSED TO 100 PERCENT HUMID ATMOSPHERE. Technical Memorandum No. 554, May 17, 1937. — Bourne. Davis.

Results of investigations on the bahaviour of rigid metal electrical conduits exposed to the corrosive effects of moist air and curing water which has been in contact with green concrete, are presented herein. Short sample lengths of half inch conduits of steel and aluminium were tested with one month's and one year's exposure, and the results are summarized.

DESIGN DATA FOR GALLERY STRESSES AS DETERMINED BY MEANS OF PLASTER-CELITE MODELS. Technical Memorandum No. 555, June 16, 1937. — Russell.

" Steel reinforcing around galleries in dams has heretofore been designed using empirical methods to determine the stresses. The purpose of this memorandum is to show the actual stresses present in the region around a standard gallery section and to present the data so that a quick approximate solution for any ordinary loading is readily available. The problem is solved by experimental analysis for 24 different conditions of loading, and the results which include surface, tangential and principal stresses are shown as graphical stress curves ".

This memorandum is a condensed summary of a report entitled "Gallery stresses as determined by means of plaster-celite models" by the writer. From the data obtained in the tests with plaster-celite models, a number of curves and charts have been prepared for the solution of stress problems around galleries. These are presented and their use is explained.

DESIGN OF ROLLER GATES. Technical Memorandum No. 562, October 14, 1937. Vetter.

This memorandum gives a description of the so-called roller gate, and outlines the principles of design of such gates. Basic principles of hydrodynamics and analytical mechanics on which the design is based are discussed and detailed methods of design developed therefrom are set forth. Examples illustrating the use of the formulæ derived are given. The methods were developed for the design of the 75 ft. roller gates of the All American Canal Headworks, and the proposed 110 ft. roller gates for the Roza Dam, Yakima Project. Illustrations of the gates of the All American Canal Headworks and a diagram showing variation of reactions of the gate are given.

LIST OF TECHNICAL MEMORANDA.

A list showing the titles and prices of technical memoranda issued by the United States Bureau of Reclamation, numbering 543. They deal with engineering problems met with in the work of the Bureau of Reclamation.

TENTATIVE FIELD INSTRUCTIONS FOR LOCATING EMBANKMENT MATERIALS AND FOR CONTROLLING EMBANKMENT PLACING OPERATIONS. July 15, 1936.

These instructions outline a tentative procedure for locating embankment materials and for controlling embankment placing operations in the field so as to obtain a stable impermeable embankment. General characteristics of material suitable for rolled embankment construction are briefly discussed. Preliminary investigations necessary before construction are described. These include prospecting for borrow pits, detailed investigations of borrow pit areas, sampling of borrow pit material, and laboratory tests of materials from test pits. The points to be taken care of for control of work during construction are described, and the general procedure to be followed for embankment work is given. General notes for embankment inspection and miscellaneous information for the guidance of earthwork inspectors are given. Detailed descriptions of field tests which include manner of obtaining and submitting samples, field density test, procedure of obtaining an despatching undisturbed soil samples, compaction test, and determining moisture content in the embankment before rolling, are also given.

PREVENTION OF SCOUR AND EENERGY DISSIPATION. Translated by Mr. Edward F. Wilsey from pages 78 to 173 of Kolkabwehr und Stauraumverlandung. Schoklitsch.

Schoklitsch's work on the prevention of scour and energy dissipation is considered to be the most complete from the engineering standpoint. His ideas and the comprehensive data collected by him from experimental research in the laboratory on models of dams and other structures are presented in this work. In addition to his own experimental work he has made detailed references to the work of other investigators and has mentioned the results and conclusions arrived at by them. Observations at actual works are also referred to, and actual works designed on the basis of model experiments are mentioned.

The author commences with a preliminary discussion of surface, ground, and bed rollers and their energy dissipating action. Numerous investigators have studied the effect of rollers on energy dissipation and some of them have obtained conflicting results. The author states that according to model tests the efficiency of a roller depends on its form, and the more the roller approaches a circular form, the less effective it is. The subject of energy dissipation is then dealt with under two heads: firstly for flows carrying silt and secondly for flows free of silt. Special structures for scour prevention are used if the discharges through the structures carry silt. The energy dissipation is carried out in subsidiary structures. The types of flow existing downstream of a dam and the corresponding scour are described, and the process by which scour is produced is explained. Model experiments of the scouring process at dams with a free overfall, dams with aprons sloping downstream, and dams with horizontal aprons were carried out by the author, and the results are discussed. Measurements of actual scour at a number of dams of the above types have been made for several years andthese are diagramatically depicted. Results from experiments on the study of scour upstream of dams and scour measuremets on the upstream of some actual dams are given. The author then proceeds to discuss various methods for reducing the scour below dams. The effectiveness of the various methods discussed was investigated by model tests and the results obtained are mentioned. These methods include a long downstream apron, a rising apron solid sills, dentated sills as originated by Rehbock, double sills, riprap placed below a solid apron, floating and shelf aprons, and check sills (walls placed downstream from the dam). Experimental results of the action of the above devices are graphically shown.

The author then passes on to energy dissipators when the flow is free of silt. These include steps or cascades, the hydraulic jump, baffle piers, stilling pools, nozzle dissipators, spiral eddy dissipators, pipe and flume dissipators, and other miscellaneous types of dissipators. Stilling pools are dealt with in some detail and rules for their design are given. Other devices and their action are briefly described and examples of actual works of the type that have been constructed are given. Formulæ for hydraulic jump calculations are also discussed.

THE MEASUREMENT OF VELOCITY AND PRESSURE IN THREE-DIMENSIONAL FLOW. Translated by Mr. Edward F. Wilsey from " Zeitschrift fur Flugtechnik und Motorluftschiffahrt ", Vol. 23, No. 13, July 14, 1932. Krisam.

An instrument for measuring the magnitude and direction of the velocity of flow and the hydraulic pressure in three dimensional flow, known as Zijnen's five hole pitot sphere, is described in this publication. Its use in practice and experience obtained in its application to practical problems are described.

National Bureau of Standards.

FLOW IN EARTHEN CANALS OF COMPOUND CROSS-SECTION. Translated and abstracted by Chilton A. Wright from " Annales des Ponts et Chaussees, Memoires et Documents ", Vol. 106, No. 5, May 1936. Hegly.

In order to improve traffic on the Rhine in a certain reach, a canal along the bank was proposed as an alternative to changing the river channel itself. This canal was proposed to be of a compound trapezoidal cross section. The total width would be 420 feet, divided equally into depths of 13 ft. and 33 ft. Navigation could then proceed upstream on the shallow part of the section against a velocity of approximately 2·5 ft. per sec. as compared to the maximum velocity of about 15 ft. per sec. in the river. There being no existing information on the hydraulic characteristics of a canal with this cross-section, a series of model experiments were undertaken to study the velocity distribution and the division of discharge between the two parts of the cross-section, considerations of similitude between models with different scales, water surface profiles, roughness coefficients, an effect of curvature. These experiments are described in this publication, the results are discussed and the conclusions recorded. The experiments were carried out on three models, two straight ones of 1/20 and 1/50 scale size of the actua lcanal and a curved one of 1/50 scale. The third one was used to study effect of curvature. The experimental procedure is described and results are tabulated.

INVESTIGATION OF FLOW OVER WEIRS. Translated by Mr. H. N. Eaton from "Mitteilungen des Hydraulischen Instituts der Technischen Hochschule Munchen", Heft 7, 1933. **Dillmann.**

When weirs are used for the measurement of flow of water in a channel, the channel in which the weir is placed is not always sufficiently long. In such cases special stilling devices such as gratings or screens are provided upstream of the weir to obtain a uniform flow in the approach channel, a condition which is postulated in the usual formulæ for weir coefficients. These stilling devices however impress certain characteristics on the flow and therefore it is found that the usual weir formulæ are not applicable. A series of tests were undertaken to investigate the effect of various forms of stilling devices on the discharge. The tests are described herein and results obtained are represented graphically and discussed.

CURRENT HYDRAULIC LABORATORY RESEARCH IN THE UNITED STATES. Bulletin V-2, July 1, 1937.

The publication contains the following information :—

1. A list of current projects in the hydraulic laboratories of U. S. A. · This includes studies on the following:—

Hydraulic turbines.

Flow conditions in open channels. Laminar and turbulent flow. Flow around bends. Velocity distribution in stream channels. Roughness coefficient. Duration curves. Backwater curves. Hydraulic jump in a trapezoidal channel, sloping aprons and channels, enclosed conduits. Submerged flow. Sub-surface flow. Flow through weirs. Mechanics of suspended bed-load transportation. Measuring rate of flow in steep channels carrying suspended load. Flow phenomena at intersection and at critical depths of streams.

Flow in pipes.

Sand and gravel sampler and sample splitters.

Hot wire velocity meter for use in water. Metering flumes. Venturi flumes. Rating of flumes for measuring debris-laden streamflow. Current meters.

River model studies. Model of estuary of Columbia river.

Locks.

Model studies of dams, spillways, cofferdams, outlet works.

Broad-crested weirs. Short-crested circular and rectangular weirs.

Similarity of moveable-bed river models. Studies on fixed bed river models.

Characteristics of sprinklers and sprinkler systems of irrigation·

Effect of depth of watertable upon the loss of water from soil surface. Movement of moisture through soils. Flow through granular materials.

Seepage from dams. Co-efficient of soil permeability. Saturation line.

Evaporation from free water, soil, and plant.

Hydraulic performance of canal drop.

Surface run-off.

Flood hydrographs.

Ground water profiles.

Flood control reservoirs.

Stilling pools and other devices.

Locks. Gates.

Stability of sand dams.

Concrete mattress studies.

2. Hydraulic Research in France.

Non-permanent regime in a rectangular channel of constant slope is one of the problems under study.

3. Hydraulic Reserarch in Canada.

Hydraulic model studies of different spillway profiles and calibration of a sharp-crested triangular weir are the subjects under study.

4. List of completed projects. These include :—

Similarity of broad-crested weirs.

Similarity of moveable-bed models.

Flood waves.

Flow conditions at intersecting streams.

Flow conditions at critical depth.

Submerged short-crested weirs.

Sedimentation basins.

Cofferdam design.

All-American Canal—" Influent Slot ".

Outlet works and spillway design of Bull Lake Dam.

Needle valve, ring-follower cylinder-follower gate characteristic.

5. List of various hydraulic research committees with subject under investigation.

6. Foreign pamphlets received by the Bureau of Standards.
7. Translations of engineering articles prepared by various institutions in U. S. A.

University of California.

THE DIGESTIBILITY OF BROWN ALFALFA HAY, SESAME MEAL, AND ARTICHOKE SILAGE AS DETERMINED FOR RUMINANTS. Bulletin No. 575, May 1934. — Folger'

University of Iowa.

THE TRANSPORTATION OF DETRITUS BY FLOWING WATER-II. — Mavis. Liu. Soucek.

This bulletin reports results of tests carried out in a flume on the transportation of bed load by flowing water. A 32 ft. long wooden flume 32 inches wide and 16 inches high was used and six samples of granular material ranging from 1·4 to 4·4 m.m. mean diameter were used as bed materials. Observations were taken for a wide range of conditions, and roughness factors in Manning's formula were determined for each test. Data obtained from more than 400 tests are analysed and empirical formulæ are derived for rates of bed load movement in terms of bottom velocity and tractive force. Details of the apparatus, materials and experimental procedure are given. Data obtaned are plotted in a number of graphs and some formulæ are derived to fit the data.

Louisiana State University, Agricultural Experiment Station.

CHANGES IN THE OXIDATION-REDUCTION EQUILIBRIUM IN SOILS AS RELATED TO THE PHYSICAL PROPERTIES OF THE SOIL AND THE GROWTH OF RICE. Bulletin No. 271, January 1936. — Sturgis.

Observations made during the past 5 years in studies on the fertility problems of the soils of the Lower Mississippi flood plain and the soils of the coastal prairies show that as a result of waterlogging due to naturally poor drainage and long continued irrigation, deflocculation and other poor physical conditions are developed and reduced products which are toxic to crops are accumulated. The effects of irrigation or waterlogging on the intensity and products of reduction, and their relation to the physical properties of the soil have not been previously determined. The object of the investigations described in this bulletin was to determine the effect of waterlogging and organic matter on the rate, intensity and amount of reduction, to study the effect of irrigation on the decrease in permeability and æration, and to ascertain the effects of certain treatments on the improvement of the physical properties of the soils. After a brief historical review of work done by previous investigators, the author goes on to describe the experimental materials and methods used by him. The experimental results are then given and discussed in detail, and methods for improving the permeability of deflocculated soils and increasing the yield of rice on such soils are suggested. The application of leguminous organic matter was found to increase the yield of rice in a deflocculated soil. The use of commercial fertilizers without the addition of organic matter was not effective. Conclusions are given.

Ohio State University, Engineering Experiment Station.

HIGHWAY SUBSOIL INVESTIGATION IN OHIO : PRELIMINARY REPORT. Bulletin No. 39. Eno.

This bulletin presents a brief résumé of the results obtained from high way subsoil investigation in Ohio carried out under the direction of Professor Eno of the Ohio State University. Information has been collected from observations in the field, laboratory experiments, and from the work of other investigators. General conclusions are given with regard to the occurrence of road failures, vertical displacement of pavements, frost action, moisture content of soils, subbases and subbase treatment, capillary moisture and soil characteristics. Recommendations for guidance in practice are given and soil tests made in the laboratory are described. The behaviour of porous subbase soils and the effect of various admixtures on them is discussed.

RUNOFF FORMULAS AND METHODS APPLIED TO SELECTED OHIO STREAMS. Bulletin No. 49. Prior.

Formulæ for computing annual run-off from rainfall are mostly empirical. The purpose of the study reported in this bulletin is to determine the accuracy that may be expected with the use of some of these formulæ in the case of certain selected Ohio streams upon which accurate stream flow records exist for at least a period of ten years. Computations of run-off are made from the most widely used.formulæ and the results are checked with actual measured run-off. The author has also proposed modifications to increase the accuracy of the fomulæ. The formulæ and methods tested by the author are : Myer's method ; line formulæ of the type F=aR—B where F is annual run-off, R the annual rainfall, and a and B are constants ; the adjusted rainfall method ; formula proposed by Vermuele ; Justin's formula ; and Grunsky's formula. Results obtained from each of the above methods are discussed and conclusions are recorded.

EFFECT OF CALCIUM CHLORIDE AS AN ADMIXTURE IN PORTLAND CEMENT CONCRETE. Bulletin No. 61. Sloane.
McCaughey.
Foster.
Shreve.

This bulletin reports experimental investigations undertaken to study the effect of calcium chloride admixture on the rate of hydration of Portland Cement and its constituent minerals, to ascertain the character of the hydration products when the Portland Cement is set up in calcium chloride solution, to determine the difference in change in moisture content between plain concrete and calcium chloride concrete during the curing period, and to determine the difference in volumetric changes between plain concrete and calcium chloride concrete during the curing period. The methods used in the tests are described and the results are discussed. Conclusions are given.

SOME EFFECTS OF SOIL, WATER, AND CLIMATE UPON THE CONSTRUCTION, LIFE, AND MAINTENANCE OF HIGHWAYS. Bulletin No. 85. Eno.

Certain highway investigations carried out jointly by the Engineering Experiment Station of the Ohio State University and the Ohio State Highway Department are reported in this bulletin. The investigations deal with subgrade treatment beneath concrete pavements, and bituminous and other types of roads, subdrainage of highways, and the treatment of special soil conditions such as marshes, peat bogs, earthslips, etc. A general discussion of soil characteristics and soil tests is given and some general conclusions from the investigations for practical guidance are stated.

THE FLOW OF WATER THROUGH ORIFICES. Bulletin No. 89. Beitler.

Results of experiments to determine the variation of discharge coefficient of sharp edged concentric orifices with pipe size, edge roundness, diameter ratio, edge thickness, and differential head, are reported in this bulletin. Several different sizes of orifice plates were tested in seven different sized pipe lines. The apparatus used is described and details of orifice plates and pipe lines used are given. The procedure of taking observations is explained and results obtained are discussed and tabulated.

THE PREDETERMINATION OF PILING REQUIREMENTS FOR BRIDGE FOUNDATIONS. Bulletin No. 90 Taylor. Morris. Burkey.

Designing and construction engineers have long felt the need for a quick, accurate, and inexpensive method for determining piling requirements under the footings of the smaller bridges and structures before starting construction. With the prossible exception of the method of driving test piles, the existing methods of testing a proposed bridge site to determine piling requirements are unsatisfactory. As a result of theoretical and practical investigations by the authors, two machines have been devised with the help of which the probable behaviour of piles can be predicted. These machines are described and their use is explained. Results of tests with the machines at a number of bridge sites are presented together with their interpretation, and these are compared with actual conditions obtained after construction. A brief discussion of the theory of piling is also included.

THE PLASTIC FLOW OF CONCRETE. Bulletin No. 91. Shank.

The term " plastic flow " is used to indicate that property of a material which is evidenced by the continuance for an appreciable time of a varying increase of deformation or strain under sustained load, or decrease of stress during sustained strain. The object of this bulletin is to assemble existing data from tests and investigations on the subject of plastic flow, to correlate them and to develop from them general principles and expressions for the use of the engineer. The data analysed are from investigations at the University of California, the Bureau of Building Research in England, and the Ohio State University. The tests at the three institutions are briefly described and results of the tests are discussed. The data from the tests are tabulated and equations for plastic flow obtained from the data are analyzed. Deductions made from a study of the data are set forth.

In order to solve plastic flow problems in structures a number of theoretical expressions and procedures are developed for columns and beams of concrete and reinforced concrete. A number of tests were made to verify the accuracy of the theoretical expressions developed in the publication, and satisfactory results were obtained.

SOIL SURVEYS FOR HIGHWAYS : Engineering Experiment Station Circular No. 33, Engineering Series, Vol. V, No. 4, July 1936. Eno.

Preliminary studies and tests of the soil on which a highway is to be built form a recognized practice at the present time which has grown up within the last fifteen years. This circular reviews briefly the status of soil surveys as part of road construction plans in the various States, and gives a brief history of the development of road soil studies in the U. S. A. It is mentioned that notes on the sampling, testing, and field control of soils for road construction have been prepared at the Bureau of Tests, Ohio Department of Highways, and are representative of the best in current soil practice. Some salient features of these notes are described. Important soil research work carried out by various investigators is briefly described and includes the works of Dr. Terzaghi, Dr. Casagrande and others.

ENGINEERING EXPERIMENT STATION NEWS : Vol. IX, No. 4, October 1937.

This is a bi-monthly publication containing short notes on engineering matters of interest to Ohio State. One of the articles in this issue entitled " Typical stream flow records " gives a graphical representation of stream flow records of certain Ohio streams for the year 1937. The graphs show rainfall and run-off by months from October 1936 to June 1937 as recorded at a number of stations selected in three different drainage basins. Features of the graph are briefly discussed.

THE USEFULNESS OF MATHEMATICS TO ENGINEERS. Circular No. 27. Ott.

The usefulness of the different branches of Mathematics to the engineer, namely Arithmetic, Algebra, Geometry, Trigonometry, Analytical Geometry, Calculus, Differential equations, etc., is briefly described.

(Translations of Italian papers received from United States of America and since returued).

A STUDY OF THE RELATIONSHIP BETWEEN THE PRIMING HEADS OF MODELS AND OF THE PROTOTYPE OF A SELF PRIMING SIPHON. (Translated from the Italian by the United States Bureau of Reclamation). Veronese.

The priming head of self priming siphons is defined as the difference of elevation between the overflow sill and the water level in the forebay at which the siphon is completely primed, or the head that is created by complete vacuum in the siphon throat. The experimental researches described herein were carried out to find the relationship between the priming head of a model syphon and the priming head of the prototype. The experiments were performed with three syphons of different types and for each type of syphon three different scale models were used. The three types of syphons and the models used are described. The procedure of carrying out the experiments is explained and results are discussed. An important conclusion arrived at from the results is that a general law relating the priming heads of the model and prototype does not exist, and the only way to determine the value of priming head for a syphon is to build and experiment on at least three models of different scales of the same type of syphon. Factors which influence the priming head are discussed and the various aspects of the problem are dealt with mathematically with a view to discover laws generally applicable.

EXPERIMENTAL INVESTIGATIONS ON SELF-LEVELLING SIPHONS. (Translated from the Italian by the United States Bureau of Reclamation). Drioli.

" The experiments described constitute, for the first time, a practically complete investigation of the different regimes of efflux of auto-levelling syphon through direct experimentation on constructed works."

The experimental scheme is described and results are discussed and dealt with mathematically. The results are also compared with results of laboratory experiments and it is concluded that the agreement between the two is fully satisfactory. The experiments are interpreted physically and hydraulically and it is shown that the agreement between the deductions from a normal hydraulic calculation and the resulting experimental demonstrations is very good.

EXPERIMENTAL RESEARCH ON AUTO-LEVELLING SIPHONS : SECOND REPORT. (Translated from the Italian by the United States Bureau of Reclamation). Marchetti.

" In a preliminary report there have been published and illustrated the results of a first elaboration of a series of many experiments on models of auto-levelling syphons instituted in the laboratory of hydraulics and hydraulic constructions in the Royal School of Engineering at Pisa..............In order however that the results and conclusions may have a more general character, it has been deemed opportune to make at the same time a general synthesis of all the results of the experiments hitherto completed both under natural conditions and in the testing laboratories, on auto-levelling syphons............ In the present note only the findings will be given that relate to the distribution of the pressure along the pipe from the intake to the outlet, the values of the pressures being deduced by piezometers applied ta successive points along the waist of the pipe."

The experiments carried out at Pisa which were not discussed in the preliminary report are illustrated herein, and tests made in other laboratories are reviewed. The question of the comparability of models and prototypes is considered.

ON EQUATIONS OF UNIFORM FLOW OF STREAMS : MEAN RADIUS AND FORM OF SECTION AS DERIVED FROM EXPERIMENTAL INVESTIGATIONS. (Translated from the Italian by the United States National Bureau of Standards). Gentilini.

" The phenomena of the uniform flow of fluid currents lack a general and complete analytical representation " states the author in his introductory note. The object of this paper is to summarize the experimental investigations thus far made on this question and to set forth the present position. Considering the greater paractical importance of turbulent flow than laminar flow, the study given in the paper relates principally to the co-ordination of experimental results obtained with the former. The author briefly reviews the progress of knowledge on the uniform flow of fluids up to the present time and discusses the various formulæ developed, including the more recent conceptions of viscosity and roughness as affecting flow. He analyses laminar flow in conduits and develops a number of relations concerning such flow which are discussed in some detail. He passes on to uniform flow in smooth conduits with turbulent regime which is treated in the same manner. He then briefly summarises the experimental work on the subject by various authorities in chronological order and discusses the results in each case. The experimental investigations include those of Schiller, Winkel, Davies, White, Cornish, Nikuradse, Lea, and Lorenz. The experimental results on smooth conduits are discussed and summarized in tabular form. Finally, the effect of the form of the section on uniform flow in conduits with rough walls is discussed.

AUSTRALIA.

REPORT OF THE MELBOURNE AND METROPOLITAN BOARD OF WORKS FOR THE YEAR ENDED 30TH JUNE 1936.

REPORT OF THE MELBOURNE AND METROPOLITAN BOARD OF WORKS FOR THE YEAR ENDED 30TH JUNE 1937.

Contains general report on the administration, financial results, and reports on water supply and sewerage works with details of new works undertaken. Statement of accounts and balance sheet are also given.

REPORT OF THE RIVER MURRAY COMMISSION FOR THE YEAR 1936-37.

Report of the proceedings of the River Murray Commission for the year 1936-37 with financial statements and details of works carried out during the year. The most important work completed was the Hume Reservoir which was opened on November 21, 1936. Amongst other works, Yarrawonga weir construction was continued. Experiments with models of energy dissipators for this weir were completed and the type of dissipator finally adopted took the form of a dentated sill downstream of the structure.

IRRIGATION WATERS OF THE BURDEKIN DELTA. **Cassidy.**
Bureau of Sugar Experiment Stations, Brisbane, Technical Communications No. 1, 1937.

The Lower Burdekin area (Queensland) consists of a uniformly flat country typical of a river delta. The outstanding feature of this region is the facility with which large quantities of water can be obtained at shallow depths, and a prosperous cane-growing settlement in this area has been established. The soil of this area is described, the sources of the underground supply and its replenishment are discussed and results of analyses of the waters of the delta are presented. It is considered that the Ca/Na ratio is the best criterion of the quality of water for irrigation, but if much free alkali be present, the water should not be used in any case. As a result of investigations it is found that the Burdekin irrigation waters are inferior in quality which will lead to deterioration of the soil for which possible ameliorants such as sulphur, gypsum, ammonium sulphate and molasses are suggested.

IRRIGATION AND WATER SUPPLY DEVELOPMENT IN VICTORIA, 1937.

A brief history of water conservation in Victoria is given. A number of schemes constructed and administered by local trusts were the early features of irrigation activities but most of them failed and in 1905 the State Rivers and Water Supply Commission was established. The duties and powers of the Commission are set forth and the irrigation systems administered by the Commission are breifly described. The progress in irrigation under the Commission is reviewed. Flood control is also dealt with by the Commission and the flood control works administered are described. The waters of the Murray River are administered by the River Murray Commission consisting of representatives of the States of New South Wales, Victoria and South Australia and of the Government of the Commonwealth. The Hume Dam has been constructed under the Murray Agreement and the Yarrawonga weir is under Construction. The State Rivers and Water Supply Commission of Victoria are carrying out investigations of erosion conditions in the catchments of the rivers.

TASMANIA.

REPORT OF THE HYDRO-ELECTRIC COMMISSION FOR 1935-36.

Contains general report, financial summary, and report on operating conditions of the Hydro-electric Department of Tasmania.

INTERNATIONAL CONFERENCES, ETC.

International Association for Hydraulic Structures Research.

REGISTER OF THE MEMBERS, Sept. 1936.

CURRENT WORKS IN HYDRAULIC STRUCTURES RESEARCH. (Bulletine No. 1—July 1, 1937).

This Bulletin contains short descriptions of researches in hydraulics carried out in various laboratories in Germany, England, Australia, Belgium, France, Canada, Hungary, Italy, Switzerland and Czechoslovakia. The object of the bulletin is not to be a collection of reports on the finished works but merely an enumeration of the work so that interested persons may know in which laboratories researches concerning certain problems have been or are being dealt with. Similar reports for researches carried out in U. S. A. and U. S. S. R. are published in bulletins of the National Bureau of Standards, Washington, and of the U. S. S. R. Commission for Exchange of Hydraulic Laboratories Research Rseults, Leningrad. Reports of researches in England and Canada only are given in English and include the following :—

The Whitworth Engineering Laboratories of the Victoria University of Manchester.

(Director Prof. Gibson). Researches carried out are :—

1. Concerning silt and salinity of the River Severn.
2. The design of piers for a bridge or sluice dam.
3. Experiments with a model sluice gate of the tilting flap design.
4. Streamline and turbulent flow in open channel.
5. Experiments on flow of water through smooth rectangular passages.
6. Study of laminar motion through rectangular passages.
7. Experiments on a scale model of the river Mersey to investigate viscosity effect, rate of propagation of flood waves, effect of eliminating bends by cutoffs.
8. Experiments on transportation of bed materials by flowing water.
9. Experimental investigation on the effect of bridge piers and other obstructions on tidal levels in an estuary.

(10) Calibration of weirs of irregular section.

Division of Mechanical Engineering, National Research Council of Canada, Ottawa.

Research was carried out in a moving stream for use in the design of emergency dams.

The following are the summaries of some of the Reports for the First Meeting of the Association held in Berlin in October 1937.

Programme No. 6—

(*a*) APPARATUS FOR THE MEASUREMENT OF THE SOLD MATERIAL CARRIED ALONG ON THE BEDS OF STREAMS. (Summaries in French and German).	Smetana.
(*b*) NOTE ON THE FORM OF THE FIXED CREST OF A MOVABLE DAM. (Summaries in French and German).	Smetana.

(*c*) SIMILITUDE OF HYDRODYNAMIC PHENOMENA WHEN WATER IS CONSIDERABLY MIXED WITH AIR. (Summaries in French and German). Smetana.

Programme No. 8--

MEASURING OF MOORING STRESSES IN LOCKS IN THE LABORATORY AND IN NATURE. (Summaries in English, German and French). Schijf.

Programme No. 12—

OBSERVATIONS AND ANALYSIS OF THE SUSPENDED LOAD OF RIVERS. (Summaries in English and German). Straub.

Extensive observations and studies were made of the suspended load of the Missouri river system. The technique of the investigations is described herein. General conclusions drawn from the investigations are set forth. Observations show that the concentration of silt in a river cross-section varies from point to point both vertically and laterally. Ordinarily the amount of silt per unit volume of water is greater near the bottom than near the surface. The variation in concentration transversely across the stream was not so pronounced, as the variation from the surface to the bottom. A heavy precipitation following a drought usually results in an abnormally high silt concentration in the water. Using the data from precise measurements to determine the distribution of silt in the river, various curves were drawn to serve as a starting point for a mathematical treatment for the rate of discharge of suspended matter. By mathematical deduction it was found that the mean silt concentration factor by which the water discharge must be multiplied to obtain the silt discharge was closely approximated by taking the sum of 0·4 of the silt concentration at 0·8 depth and 0·6 of the silt concentration at 0·2 depth. As regards mechanical composition of the suspended load, several interesting results were obtained. It was found that for the finer particles the viscosity as well as density of the fluid comes into consideration and the sedimentation is governed by Stokes Law. The finer particles were quite uniformly distributed throughout the river cross-section regardless of variation in turbulence. The coarser particles follow Newton's law in sedimentation and were mostly concentrated in the lower part of the river. It was found possible to establish silt discharge rating curves for large rivers which would give reasonable values of the suspended load as related to water discharge over long periods of time. For smaller streams the relation of silt discharge to water discharge was not as well defined as for large streams.

Programme No. 17—

EXPERIMENTAL INVESTIGATION OF VARIOUS TYPES OF SELF-PRIMING SYPHONS USING SCALE MODELS. (Summaries in English, German and French). **Bonnet. Blockmans. Lamoen.**

Programme No. 32—

CONTRIBUTION TO THE QUESTION OF SUB-TERRANEAN EROSION IN SANDY SOILS. (Summary in German). **Bernatzik.**

Permanent International Association of Navigation Congresses.

Bulletin No. 24—July 1937.

This bulletin contains a report of the proceedings of a meeting of the Permanent International Association of Navigation Congresses held in Brussels on June 8, 1937. It includes the annual report of the Executive Bureau for the year ending 15th May 1937 dealing with financial and administrative matters, a verbatim report of the meeting held on June 8, 1937 in Brussels, and an account of the excursion in Germany arranged for the members of the Commission on the occasion of the meeting. The excursion included an inspection of the rivers Rhine, Main and Danube and the Nickar canalisation works.

Abstracts of the following papers are included in the Bulletin : -

HAS FLOOD CONTROL CHANGED THE HUNGARIAN CLIMATE ? **Rethley.**

For notes *see* page 37 of Quarterly Bulletin No. 4.

MOLES HAVING VERTICAL SIDES. **Mendonca.**

The author gives a summary of theoretical considerations upon which calculations for the design of vertical moles are based. He clearly sets forth the movements of the liquid particles in the case of undulatory movements and presents a graphical representation of the movements. He gives an analysis of the propagation of waves and discusses standing waves caused by the backwater of propagation waves from a vertical wall. Details of calculations for a vertical mole are given and tests on reduced scale models are referred to.

STABILITY OF EARTHEN DAMS UNDER THE ACTION OF CONSTANT OR VARYING PRESSURE. **Smrcek.**

In connection with the regularization oft he Waag river in Czechoslovakia for the development of agriculture, navigation, and power for industrial purposes, a plan was drawn up which required the construction of canals with earthen embankments and earthen dams on the river. To determine precisely the stability of such structures a number of experiments on scalar models were carried out by the author in the Hydraulic Laboratory of the Brunn

Technical Faculty. These tests are described in detail in this paper. The tests were made with models of dykes built of different earth materials as below :—

Dyke made of gravel without any foundations.

Gravel dyke on a foundation of gravel and loess soil from the Waag Valley.

Dyke with loess core and foundation.

Gravel dyke with a loess core without any foundation, materials saturated with moisture.

The investigations were mainly directed to the determination of the behaviour of the material in the dyke under the action of upward pressures and to trace the movements of the seepage water in the body of the dyke for various upstream loads of water. A number of diagrams showing pressure lines and seepage flow lines in the models tested are given.

Experiments were also made for verification of the laws of similitude in models and prototypes. Details of these experiments are not given but conclusions derived are recorded.

For flood embankments along the river Waag study was made on models of the manner in which flood water penetrates into the embankments, the speed of the seepage, the shape of the lines of seepage flow and dis-aggregation of the embankment in case of prolonged floods.

Results of the experiments are discussed in each case and the conclusions drawn are given.

International Society of Sugarcane Technologists.

PROCEEDINGS OF FIFTH CONGRESS, BRISBANE, 1935.

This volume contains a report of the fifth Congress of the Society held in Brisbane from 27th August 1935 to 3rd September 1935. Three delegates from British India attended the Congress including Rao Bahadur Venkataraman, Government Sugarcane Expert, Imperial Sugarcane Station, Coimbatore. Details of the official opening ceremony including addresses by the Governor of Queensland and the General Chairman are given. Papers presented before sectional meetings of the Society under the following sections are given : Agricultural Section, Pathological and Entomological Section, Cane Breeding Section, and Manufacturing Section. The papers number over 90 amongst which are the following :—

1. Importance of virus diseases of sugarcane—by Brandes and Matz.
2. Symposium on the methods of maturity determination in sugarcane.
3. Cane trash and soil organic matter by Stieglitz.

4. Progress of sugarcane root rot studies in Hawaii—by Carpenter.
5. Frost damage in cane and some experiments to minimise its intensity—by Barton.
6. Symposium on the methods of seedling selection.
7. Biological control of sugarcane pests in the British West Indies and British Guiana—by Myers.
8. Irrigation in the Lower Burdekin district--by Tapiolas. *See* also under "Publications of Australia".
9. Drainage methods in Fiji—by Clarke.
10. Surface drainage in the Mackay district—by Clarkson.
11. Disease resistance tests on sugarcane seedlings—by Rands, Abbott, and Summers.
12. Report of Committee on Soils.
13. Report of Committee on Labour Saving Devices.
14. Rapid field tests for soil fertility--by Steiglitz.
15. A brief review of some important contributions on soils and fertilizer investigations--by Schreiner and Deemer.
16. Methods to determine fertilizer requirements of sugarcane in Louisiana—by O'Neal and Hurst.

OTHER PUBLICATIONS.

THE USE OF SLAG CEMENT FOR THE CONSTRUCTION OF LARGE DAMS. (In French). (Extract from "Science et Industrie", edition "Travaux", July and August 1937). Langavant.

This paper commences with a short history of dam construction from the point of view of the materials used, and then deals with the properties required of special cements used in the construction of large dams. The author then describes in detail the hydraulic properties of slag from blast furnaces, and the cements prepared from it, and mentions several dams which have been constructed with this material. An appendix contains comments on the subject by M. Freyssinet.

CATASTROPHIC FLOODS IN THE UNITED STATES IN MARCH 1936 AND JANUARY 1937. (In French). Parde.

This note describes the floods in March 1936 and January 1937 in the United States of America, and gives particulars of rainfall and melting of snows to which the floods are attributed.

THE DISASTROUS FLOODS IN MARCH 1936 AND JANUARY 1937 IN THE UNITED STATES. (Extract from "Materiaux pour Etude des Calamites" fasc. 39, 1937.—In French). Prade.

This paper deals with the heavy floods experienced in America in March 1936 and January-February 1937. From a study of the rainfall figures in the various catchments, and flood levels at various gauging stations in the rivers, conclusions are reached as to the causes of the floods. The data are compared with previous record floods in the same basins. The paper concludes with a brief description of the proposed protective works, which are mostly the construction of storage reservoirs for retardation of flood water.

THIRD TECHNICAL REPORT OF THE NATIONAL SOCIETY OF THE RHONE. 1937. (In French.) Aubert.

This is the third technical report of the Company, and it deals with the general development and improvement of the river Rhone in France, and its canal systems. The first chapter deals with hydro-electric development, and discusses the investigations in hand for ascertaining the power available. Chapter two deals with navigation, and details of river training, and their study by the use of models are given. This chapter also deals with the management and development of the inland port of Lyon.

BORDEAUX AND THE GIRONDIN ESTUARY. (In French.) Leveque.

This publication contains a detailed description of the Girondin estuary in France and the adjoining sea-coast. It describes the geological formation of the coast line and traces the history of the action of the sea upon it. The estuary is compared with other similar ones in Europe. The transportation of solids by the river and formation of the delta is discussed, with notes on the action of prevailing winds. Details are given of the construction of a deep channel through the estuary by dredging, and they include useful information on the design of dredgers. The second part of the publication contains annexures dealing with dredgers and pumps, depth sounding apparatus, and the port of Verdon, with particulars of hydraulic shock absorbers provided on the quayside.

COPY OF D. O., DATED 21ST NOVEMBER 1937 FROM MR. W. E. BUSHBY, SUPERINTENDING ENGINEER, EASTERN SIND CIRCLE TO THE SECRETARY, CENTRAL BOARD OF IRRIGATION REGARDING GUNITE LINING WITH HYDRAULIC LIME USED ON NIRA RIGHT BANK CANAL.

Reference is made to Quarterly Bulletin No. 7, page 152 wherein an abstract of a letter from Mr. Aitken, Superintending Engineer, Deccan Irrigation Circle regarding gunite lining was published. Mr. Bushby was Executive Engineer of the Division in which the work was carried out. The lining of the approach channel on Mile 1 of the Nira Right Bank Canal and in the cutting in Mile 7 of the canal was carried out with the use of a cement gun and hydraulic lime. The lining was not constructed to stop leakage, but to reduce N so as to allow a small section to be excavated through the rock. In carrying out the work, about 2 ft. more than the designed section was blasted out. The sides were then roughly made up with rubble, and hydraulic lime mortar was applied with a gun to fill in the interstices, and finish off the surface smoothly. Mr. Bushby believes that this is the first work in India where hydraulic lime was applied successfully with a gun in place of cement.

NOTE ON ASPHALT REVETMENT. Moore.

In this note Mr. Moore describes the development of asphalt revetments for river bank protection in the United States and discusses the possibilities of this type of revetment for river bank protection in Bengal. Existing types of revetments used in Bengal are mentioned and costs are given. These include mass concrete paving, concrete block pitching, stone boulder pitching, dry brick pitching, wire enclosed brick mattress, and brushwood matting. Requirements of river bank protection and causes of failure of revetments are discussed. The qualities of revetment types used in Bengal are discussed. Some types of revetments used on the Mississippi are described and the development of asphalt revetment in U. S. A. is reviewed. The details of this type of revetment with method of construction and costs are given and the advantages claimed for this type are enumerated. Possibilities of introducing this type of revetment in Bengal are then discussed with particular reference to conditions in Bengal which are different from those in the U. S. A. Mr. Moore has framed an estimate for conducting preliminary experiments with reinforced mattress and ordinary asphalt paving with asphalt, filler, and sand locally available. If necessary the possibility of producing a thin asphalt lining suitable for irrigation canals could also be investigated on the same lines. Though the first cost of this revetment is high as compared with the cost of the commonly used types, the maintenance costs would be negligible and its effectiveness would be greater. A copy of the estimate is attached to the note.

NOTE ON SOIL PHYSICS AND SOIL WATER RELATIONSHIP. Anand.

This note is an account of studies pursued at Oxford, and visits to experimental stations in Holland and Hungary during January and February 1937 while the author was on leave. The author attended the soil science laboratory at Oxford for 4 weeks and studied the following subjects :—

1. General soil physics, mechanical analysis, capillarity, permeability and shrinkage.
2. Colloids, particle size, flocculation, dispersion, hydration, etc.
3. Properties of clay, base exchange, difference between calcium, sodium and hydrogen clays, types of clay.
4. Clay acidity, crumb structure, black and white alkali soils.
5. Soil water relationships, field moisture, capacity, evaporation, etc.

In mechanical analysis, an international scale of particle sizes has been adopted. This scale is given and shows the diameters of particles of different soils such as clay, silt, fine sand etc. The methods of mechanical analysis are based on Stokes Law. Some conclusions from capillarity observations in the laboratory having a bearing on irrigation, agriculture and drainage are given. One of the conclusions is that films of water will not completely surround particles but will be in the interstices between them if the particles are not below ground water level. Another is that usually water level in a pipe or well in the ground is taken to be the subsoil water level, but actually the ground in the vicinity is saturated to a height a little above the level of the water in the well or pipe. Some characteristics of permeability are described. Permeability depends upon the mechanical structure of soils and great care is necessary in deep cultivation as it may alter the structure of the subsoil and make it impermeable. The imprisoned air in the soil is an important factor and explains the presence of the " dead layer " which is a comparatively dry layer separating the wet surface layer due to irrigation, etc. and the wet subsoil layer due to subsoil water. Saturated and unsaturated flow conditions due to percolation from the bed of a channel and the effect of percolation on the " dead layer " of soil are discussed. Conditions of flow in drains in permeable light soils and in heavy soils are described.

Colloids occupy an intermediate position between coarse suspensions and true solutions. General characteristics of colloids are described. Properties of clay in general and the properties of calcium, sodium and hydrogen clays are given, with their definitions. Salt movement in soils is discussed and factors governing salt movement in soils are mentioned. Soil classification according to p^H values as adopted in the Punjab is given. Phases of soil deterioration by salinity and remedial measures as adopted in Hungary and elsewhere are described. Method of determining p^H values of soils is briefly outlined. Soil water relationships in irrigation are discussed and some conclusions of practical value are set forth, *e. g.* (1) " In the initial stages of plant growth, a smaller quantity of water should be supplied as any water that goes below the root zone is practically lost to the plant ". (2) " The sub-soil, owing to being under pressure, is usually more compact than the top-soil and hence has a less pore space. Thus a smaller addition of water is required to saturate it and raise the subsoil water level. If the subsoil is fairly saturated, even a rainfall of 1″ sometimes causes a rise of 1′ in sub-soil water level ". (3) " The water holding capacities and water movements in soils depends greatly on the physical properties like the texture, the quantity and quality of organic matter present, etc. and the chemical composition of the soils ".

"Thus it will be seen that the quantity of irrigation water required for crops will depend on a number of factors which have all to be taken into account while fixing duties and deltas, which will vary with the climate also." Finally, an account of visits to Holland and Hungary and items of interest seen in those countries is given. Reclamation from the sea as practised in Holland is described. Mention is also made of interesting experiments on plant growth and treatment of seed being carried out at Budapest University.

THE USE OF MODELS FOR ELUCIDATING FLOW PROBLEMS —BASED ON EXPERIENCE GAINED IN CARRYING OUT MODEL EXPERIMENTS AT THE HYDRODYNAMIC RESEARCH STATION, POONA.

Inglis.

In order to find proof or disproof of the reliability of open channel experimentation the Director of United States Waterways Experiment Station at Vicksburg issued circular letters to more than fifty laboratories and individuals engaged in hydraulic research. The replies received did not give much information pertinent to the subject and the conclusion drawn was that little or no information was available in justification of moveable bed models. No copy of the circular letter was sent to Mr. Inglis, and this paper has been written by him to supply information regarding the behaviour of various types of models used in hydraulic research, based on his own experience. The eight main types of hydraulic models used are described with examples showing why some types present little difficulty and give results suitable for immediate application whereas other types specially those relating to alluvial rivers present very great difficulties. Geometrically similar models in which parallel flow or free vortex flow are established give geometrically similar results provided they are not too small to make it possible to reproduce the boundary conditions of the prototype. In other cases similarity is not attained. Two models, namely, the crump type standing wave flume and the Gibb nodule are discussed in some detail and reasons are given as to why geometrically similar discharges were given by these models. The model of a high coefficient weir for Lake Arthur Hill at Bhandardara which is now under test at Poona is an example of a model which is geometrically similar in shape but does not give geometrically similar results. Some details of investigations with this model and the results are given. Models of channels in incoherent alluvium are then considered and the recent investigations of Mr. Gerald Lacey on regime channels as affecting model experiments are discussed. It is shown that the discharge required to establish regime increases inversely as the square of the silt factor, and therefore the coarser the silt the smaller the discharge required. Much larger discharges are required if the silt used in the model is fine. Regime models are not required for designing regime channels because the Lacey formulae give far more accurate results than can be obtained by applying model results but they are helpful in determining silt movements. Experience at Poona shows that model silt charge is markedly different to that in the prototype. Mr. Inglis then passes on to combined erodible and rigid models and shows why such models cannot reproduce prototype conditions. Tidal models are an example of semi rigid models in which conditions are imposed, the sides, and in many cases the bed, being held against scour. Such models give valuable results if correctly designed, but the fact that conditions are imposed must not be overlooked. Rigid models are used in America for determining the effect of cut-offs on upstream water levels and they give results as to the immediate effect of water levels upstream. Models with mobile protections such as falling aprons, spurs, and pier and pavement protection give geometrically similar results of great value and have been successfully used at Poona. Meandering river models and combined rigid mobile and meandering river models present many difficulties. Two models, one of the Indus River 7 miles above and 3 miles below the Sukkur Barrage, and the other of the River Ganges 40 miles above the Hardinge Bridge and 15 miles below it which are under test at Poona are described in detail, and the difficulties presented in each case are described. To solve these difficulties experiments to determine the scale effect of various factors are separately carried out and the results are applied to the large full length models to enable them to give accurate results. The main fact which is stressed is the importance of large models which give results of highly qualitative accuracy and sometimes give quantitative accuracy.

IRRIGATION RESEARCH IN BOMBAY 1916—37.

A brief review of irrigation research work carried out in Bombay from its initiation in 1916 to date, is given in this note. A special irrigation Division was created and the work started with the investigation of damage caused by waterlogging, salt efflorescence or sodiumization in the Nira Left Bank Canal tract and methods of reclamation and drainage. Hydraulic research soon followed and the first model experiments were in connection with the alterations to the Head Regulator of the Nira Left Bank Canal to enable more discharge to be passed. The problem was successfully solved by adding a bellmouth upstream and expanding barrels downstream. Experiments in connection with remodelling masonry works and channels of the Nira Left Bank Canal were also successfully carried out. In 1918 the work of pumping Poona sewage for disposal by irrigation was started and the effluent experimental farm was opened. Rain and river gauging work was also handed over to the special division in 1934. In 1927 the Irrigation Development and

Research Circle was opened and at about this time hydrodynamic questions relating to the Lloyd Barrage Project began to be referred for solution by model experiments. The most important problems dealt with were :—

1. Altering the Barrage Basin to give minimum afflux during floods and to make the standing wave form just downstream of the Barrage instead of at the end of the apron.
2. Exclusion of heavy silt from right and left bank canals.
3. Design of new type of regulator fall for canals. A new type of fall known as "the proportional standing wave flume meter fall with baffle and deflector" was evolved which has since proved highly satisfactory.

In 1930 a hydraulic research laboratory was opened at Karachi for testing small models of various structures and a large number of experiments have since been carried out there, the results being published in a number of Bombay P. W. D. papers. An important investigation carried out in the Deccan was in connection with weeds in the Deccan Canals which demonstrated that weeds can be killed off by suitably timed canal closures. At the end of 1934 model experiments on a model of the river gauges and Hardinge Bridge at Sara were started at the request of the Hardinge Bridge Committee. Brief details of these experiments are given and the experiments in this connection are still in progress. A list of other experiments in progress numbering 27 in all is given. It is estimated that the saving which has been effected by research on the Lloyd Barrage and Canals Construction exceeds Rs. 60 lacs and that in the Deccan exceeds Rs. 40 lacs.

COPY OF LETTER NO. G.-8, DATED THE 24TH MAY 1937 FROM THE EXECUTIVE ENGINEER, SOUTHERN DADU DIVISION, SIND TO THE SUPERINTENDING ENGINEER, WESTERN SIND CIRCLE, REGARDING WEEDS IN CANALS AND DRAINS.

In reporting on his experience with the weed *Typha Elephantia* (Pan grass) the writer says that weed grows in clear, shallow and slow moving water, and that it does not grow thick in channels where there is an appreciable amount of silt or where the depth of water is over 3 ft. It is believed that the greater the velocity of water the less the growth of the weed.

As regards prevention of the weed growth, two methods are given. One is to dry the channel, plough it deep, turning over the roots, and exposing them to the sun for a few months. This will succeed only if no fresh seed enters the channel. This method has not been tried by the writer but was recommended by the

Department of Agriculture. The other method, which is considered to be better and cheaper, is that of broadcasting " Lari " rice (red rice generally grown in Lower Sind) just at the commencement of the hot weather and after cutting the existing weeds. Once this rice germinates (it germinates in water less than 1 ft.), it will prevent the weeds from sprouting. This method has been successfully tried.

CATALOGUE AND PRICE LIST OF THE HASKELL CURRENT METERS AND THE RITCHIE-HASKELL DIRECTION-CURRENT METERS. Faber.

HEATING AND AIR-CONDITIONING OF BUILDINGS. Kell.

This book deals with various methods of heating and air conditioning of different types of buildings and contains the latest data available on the subject. There are nineteen chapters of which the first fifteen are devoted to heating of buildings. The book starts with the description and definition of various terms used by the heating engineer. Some general problems in connection with heating are dealt with, such as heat required to maintain a given temperature, heat losses, temperature control, etc., and considerations affecting the choice of a heating system. Various heating systems with details of equipment and accessories are described together with various types of boilers and fuels used, methods of feeding, boiler mountings, and chimneys for boilers. Examples illustrating the method of calculating theoretical efficiency of boilers are given. Oil firing of boilers is dealt with in some detail because of its special advantages. Warming by hot water is used more extensively than any other system because of its simplicity, and three chapters are devoted to this method. Various types of hot water rediators, panels and other arrangements used are described. The piping system which connects the boiler with the heating surfaces is an important part of the equipment and is treated in great detail. Hot water supply for domestic use is next considered and various plants for hot water supply and piping systems are described. Heating and hot water supply by gas, electricity and steam heating are then discussed with regard to the comparative merits of each and brief details of the equipment and their arrangement in each case are given. Initial and running costs are also compared. Chapters 16 and 17 are devoted to air conditioning. The general considerations relating to air conditioning are reviewed and various air conditioning systems are described together with design of plants. Typical calculations for the design of an air conditioning system are given. Some air conditioning plants are described with particular reference to the principles of operation. The next chapter is devoted to a discussion of principles of refrigeration and description of some types of refrigeration plant for cooling air in buildings. The last chapter deals with the use of waste heat from a private electricity generating plant for heating purposes.

The book contains 75 tables which are of great value to the designing engineer, and about 270 illustrations. Details of running and installation costs of various types of plants are a special feature of the book.

HYDRO AND AERO-DYNAMICS. Green.

This is a text-book for advanced students of hydraulics, physics, aeronautics and mathematics and contains a mathematical treatment of the various aspects of the theory of motion of fluids and is based on lectures delivered at the Queen Mary College, University of London. There are ten chapters of which the first eight are concerned with the flow of a perfect fluid. They deal with equations of motion, continuous and discontinuous motion in two dimensions, vortex motion in two dimensions, wave motion and standing waves, motion in general, equipotential surfaces and stream lines, and flow past a sphere. The motion of a viscous fluid is considered in the last two chapters. Steady motion between fixed parallel planes, steady motion through a uniform tube, laminar flow, rotating liquid with cylindrical boundaries, motion past a sphere, the boundary layer, flow past a flat, plate Blassius's solution, turbulence, and Reynolds number are dealt with in these chapters. In each case a mathemetical analysis of the problem is given and some relationships are derived which define the flow and other characteristics concerning the problem. Exercises for solution are given at the end of each chapter.

QUESTIONNAIRE ON HYDRO-ELECTRIC PROJECTS.

Questions framed by Mr. J. D. H. Bedford in connection with the United Provinces Hydro-electric Grid Scheme and Tube Well Irrigation Project, and replies thereto by Sir William Stampe are contained herein. The questions relate to capital and working costs, energy output, load factor, actual loads experienced, cost of production of energy, rates for tube-well irrigation, duties obtained in *kharif* and *rabi*, number of waterings in tube-well irrigation, and financial results of the schemes.

ENERGY THEORY OF TURBULENT FLOW OF LIQUIDS. BLENCH.

"The object of this paper is to find by using Hamilton's principle the energy relations behind authoritative flow formulæ and thereby establish a new flow formula for rough conditions of rigid channels and pipes. Incidentally a further meaning is given to certain quantities whose exact nature is not known."

The author reviews existing flow formulæ starting from Chezy's equation to more recent developments associated with the names of

Prandtl, Nikuradse, Von Karman and others, which include the introduction of conceptions of boundary layer, boundary turbulance, roughness viscosity and mixing, velocity in relation to flow problems. Prandtl's and Manning's formulæ are discussed and their features are explained. The new formulæ for rough and smooth flow evolved by the author from energy principles are given and it is stated that they receive strong confirmation from hydraulic flow data and are derived from the same fundamental law. Flow within incoherent boundaries is next considered and the Lacey flow equations are analysed. The author then passes on to explain Hamilton's principle and the energy dissipation equation. Energy dissipation equations for rigid rough pipes and channels are derived and flow equations are obtained from them. Rough channels and pipes have the same flow equations and a study of the various relations obtained shows that Lacey's turbulence criterion $\frac{V^2}{R}$ is a measure of the internal resistance per lb of fluid to the upward moving eddies. Flow equations for smooth pipes and channels are derived from the same energy relationships as in the case of rough ones. Lacey's flow formula and regime test formula are then studied and the physical significance of some of the concepts involved is explained. Finally, some conclusions drawn from the results of the analyses contained in the paper are set forth.

REINFORCED BRICKWORK: A SURVEY OF ITS PRINCIPLES, PRESENT STATE OF DEVELOPMENT AND POTENTIALITIES.

A bulletin issued by the Clay Products Technical Bureau of Great Britain. Reinforced Brickwork is defined and the development of reinforced brickwork construction is traced. Advantages of this form of construction are described. The method of design is discussed theoretically and the method is applied to designing a beam. Other forms of structures for which reinforced brickwork may be used with advantage are mentioned and include foundation walls, chimney stacks, ceilings and floors. Notes and tables for design of reinforced brickwork beams and slabs and specifications for guidance in construction are given.

HAMILTON—M. A. N. DIESEL ENGINES FOR IMPERIAL IRRIGATION DISTRICT AT BRAWLEY, CALIFORNIA. (Reprinted from the February 1937 issue of "Diesel Progress".)

The All American Canal which is now under construction will have five hydro power plants installed along its length. A standby plant was also a part of the power development plans and a Diesel Engine plant has been installed at Brawley. This illustrated brochure describes the Diesel engines and subsidiary equipment.

The Law relating to Electrical Energy in India and Burma being the Indian Electricity Act 1910.

Meares.

High Service Low Cost Roads.

A pamphlet issued by Solvay Sales Corporation, New York on improving wearing qualities and lowering the cost of maintenance and construction of unpaved roads with Solvay Calcium Chloride. This material is produced in the form of small white flakes which absorb moisture from the air and dissolve themselves. The material is spread on the road surface by a special spreading equipment and provides surface binding of the road material. Details of its action and uses are given.

Dust Control and Road Soil Stabilization with Columbia Calcium Chloride.

A pamphlet issued by the Columbia Alkali Corporation, Ohio, on the use of Columbia Calcium Chloride for road surface treatment of unpaved roads.

Copper-Nickel Alloys.

A bulletin of the International Nickle Company, New York, describing the use of " Monel " a copper nickel alloy for parts of dams, flood control works, locks, river boats, etc. Records of the performance of copper nickel alloys in various installations when they have been exposed to abrasion and corrosion are given to show the excellent qualities of the material.

Inter-Provincial Power Development in India: Some Preliminary Ideas on the Possibilities of Inter-Linked Power Schemes for Different Provinces and States. March 11, 1937.

Stampe.

The object of the paper is to suggest briefly certain methods for implementing the principles which were broadly outlined in an article entitled 'Power and Progress' contributed to the *Statesman* of September 1, 1937. This article deals with the possible methods and sources of power development in India and the development of power in relation to industrial progress. In the present paper it is stated that cheap power is one of the important solutions of many of the economic problems common to all Provinces. Locally generated current in small towns must necessarily be more expensive than energy derived from a widespread grid system. One important factor which can be of mutual assistance to the development of cheap power in the three Provinces of the United Provinces, the Central Provinces and Bihar is the water resource of a neighbouring State. A case exists for the development of these resources for pumping schemes in the south eastern areas of the United Provinces. If demands from the Central Provinces and Bihar can be co-ordinated a case can be made out for a more economical development to the advantage of all. An important aspect of the problem is the stage at which it becomes more economical to construct additional generating plant than to expand the network. This is discussed in detail with reference to experience in the United Provinces. Other questions requiring examination are the relative cost of generation by steam and water power and the relative cost of transmission over long distances and shorter systems with more generating stations. Figures of costs on the Ganges canal are given together with figures for the Uhl River scheme and Mysore scheme. Operating costs are then discussed and it is concluded that economic advantage in generation generally lies with hydro generation provided the bulk of the load is within a radius of 150 to 200 miles of the source of power. It is suggested in conclusion that Provinces concerned should investigate the most advantageous procedure for co-ordinating their power requirements, in conjunction with State authorities where necessary.

MAPS, BLUE PRINTS AND PHOTOGRAPHS.

All-India.

Maps showing lines of precise levelling and tidal stations. (Corrected to September 1936).

Map showing triangulation series and azimuth stations. (Corrected to September 1936).

United Provinces.

Ganges Valley State Tube-Well Irrigation Scheme—Map showing tube-well areas and main grid lines. (Plan No. 2 extracted from the Ganges Valley State Tube-Well Irrigation Scheme Report of 1936.)

Punjab.

Sketch showing geological sections of bed of river Chenab at Merala. 27th September 1937.

General.

Mr. C. C. Inglis's amended design of a canal fall. (The original design was reproduced in the last Bulletin. The amendment has been reproduced in this edition.)

Mr. A. M. R. Montagu's design of the above-mentioned fall. (Reproduced in this Bulletin).

NEWSPAPER CUTTINGS.

POONA RESEARCH INSTITUTE : TO BE MADE ALL-INDIA STATION : INTERESTING EXPERIMENTS IN 1936-37.

August 8, 1937.

Gives the financial position of the Khadakvasla (near Poona) Research Station and its possibility of becoming an all-India Research Station for Irrigation and Hydrodynamics.

Also gives briefly the experiments that have been carried out at this Station during 1936-37. The experiments include problems of river training, storage reservoirs, canal falls, etc.

VAST AREAS UNDER CANE CULTIVATION: RS. 6½ CRORES WORTH OF CROPS RAISED IN SARDA CANAL AREA. October 3, 1937.

See page 115 of Quarterly Bulletin No. 7.

HELPING FARMERS IN TRAVANCORE : GOVERNMENT PLANS. October 5, 1937.

In replying to a deputation of the ryots the Dewan of the State said that the government of the State would prepare a comprehensive programme to combat hardships to them. This scheme would include the improvement of irrigation projects, supplementing them, and conducting a survey of the water resources.

IRRIGATION IN TRAVANCORE : IMPROVEMENT SCHEME TO BE TAKEN UP. October 5, 1937.

A general scheme for a rehabilitation of the irrigation system in South Travancore was explained by the Dewan in an interview. He said that investigation for irrigation facilities and survey of water supply resources would be immediately taken up and the government would pay particular attention to the restoration of tanks which had been assigned away and which were of considerable value as supplementary irrigation reservoirs.

TUBEWELL IRRIGATION : PUNJAB TO UNDERTAKE SCHEME. October 5, 1937.

The Punjab Government is understood to be considering a scheme of introducing tube-well irrigation in the arid south-eastern districts of the Punjab where canal irrigation cannot be arranged. The Finance Minister is visiting the tube-well scheme in the U. P. after which he will hold consultations with Punjab irrigation experts.

MORE WATER FOR TRAVANCORE : IRRIGATION SURVEY. October 6, 1937.

In addition to the remarks under the news, dated October 5, 1937 above, the Dewan dwelt on the possibilities of well irrigation worked by wind-mills.

CURRENT TOPICS: TUBE WELLS. October 6, 1937.

Editor's notes regarding the Punjab Government's proposal to introduce tube-well irrigation and the Finance Ministers visit to the U. P. tube-well scheme in that connection.

DEVELOPMENT AND AGRICULTURE : NEW PORT-FOLIO IN THE GOVERNMENT OF INDIA : RUSSELL-WRIGHT RECOMMENDATIONS. October 7, 1937.

It is stated that, in view of the large-scale plans for agricultural planning on a nation-wide scale recommended by Sir John Russell and Dr. Wright, there should be a separate department of Development and Agriculture in the Government of India. It is also stated that it is better to bring together all research and scientific departments like forestry, geology, nutrition, irrigation, etc.

AGRICULTURE IN RUSSIA : SEVEN YEAR'S PROGRESS : SETTLING DOWN TO COLLECTIVISATION : SIR JOHN RUSSELL'S IMPRESSIONS. October 7, 1937.

Sir John Russell's impressions gathered during his recent visit to Russsia. He mentions the development in agriculture that has taken place since his first two visits in 1930 and 1934.

THE EASTERN GRID PROJECT : SOME REFLECTIONS ON SIR WILLIAM STAMPE'S REPORT. October 7, 1937.

This is an article by Prof. Bhim Chandra Chatterjee, commenting on Sir William Stampe's claim in his preliminary Report (abridged) on the Eastern Grid System that the Project has been a success. The Professor gives figures of certain other hydro-electric projects, compares them with similar figures for this system, and points out that the scheme has not been a financial success.

AGRICULTURAL RESEARCH IN INDIA : EXTENSION OF COUNCIL'S ACTIVITIES : SIR JOHN RUSSELL'S RECOMMENDATIONS : ESTABLISHMENT OF CROP PRODUCTION COMMITTEE. October 7, 1937.

Gives Sir John Russell's recommendations regarding the lines on which improvement and enlargement in the Imperial Council of Agricultural Research's activities is necessary.

BABU RAJENDRA PRASAD ON FLOOD PROBLEM : GOVERNOR'S SUGGESTION. October 8, 1937.

Babu Rajendra Prasad's study of this problem raises the following problems for consideration.

(1) It is true that river beds and other channels of drainage are getting reduced in their capacity.

(2) To what extent is this reduction in capacity due to (*a*) natural causes which have been in operation for a long time, such as the transfer of sands from the hilly regions, and (*b*) to sudden natural causes such as the earthquake.

(3) Has there been a general disturbance in the level of North Bihar due to esarthquake or other causes ?

(4) Has there been deforestation on a scale sufficient to affect this question ?

(5) To what extent are railway embankments, roads and other private or public embankments responsible for the obstruction to a free flow and spread of rain and flood water over large areas ? He says that it is an inter-provincial question and suggests that the first step should be a joint conference of experts and others interested so that a common line of action may be evolved.

The Eastern Grid. October 8, 1937.

Editor's notes on Prof. Bhim Chandra Chatterjee's criticism of Sir William Stampe's Preliminary Report on the Eastern Grid.

Central Board of Irrigation : change in name likely. October 9, 1937.

States that it is likely that at the ensuing meeting of the Central Board of Irrigation which commences on October 30 the name of the Board may be changed to " Central Board of Irrigation, Hydro-Electricity and Flood Control " as it deals with these subjects also.

Kumaun Grid Project : Preliminary Investigations. October 10, 1937.

The U. P. Assembly has sanctioned the budget provision to cover the cost of an examination into the feasibility of electrifying Haldwani, Kathgodam, Bhowali, Ranikhet and Almora. Sir William Stampe and Mr. Gerald Lacey have since inspected the site of a possible power station on the Gaula Canal near Haldwani where it is understood that it will be possible to generate 400 k. w. at a cost of between Rs. 8 lakhs and 10 lakhs.

Uhl Hydro-Electric Scheme Development Plan : Grid System to cover Towns up to Delhi. October 10, 1937.

At present four 12,000 k. w. generators are installed in the power house at Joginder Nagar being capable of taking a peak load of 36,000 k. w. or 48,000 h. p A further stage will be reached when the water which has already gone through the turbines at Joginder Nagar will be carried further along the spur to a place four miles away where it will be utilized through another set of turbines as it falls through a height of 1,200 ft., thereby developing another 48,000 k. w.

Upper Reaches of Hugli : Survey Carried out : Is River Becoming Inland Sea or Lagoon ? October 11, 1937.

Investigations recently made by the Zoological Survey of India in the upper reaches of the river Hughli point out that a diminishing quantity of water at present flows down the river from Nadia the point where it separates from the main stream and that the channel of the river has gradually become very shallow resulting in very little fresh water flowing down the river at most times of the year, with the result that this part of the river has been transformed into an inland sea or lagoon.

Working of Deccan Canals : Committee to Enquire into Conditions. October 11, 1937.

It is understood that the Bombay Government propose to appoint a committee to enquire into the conditions of the working of Deccan canals, with special reference to the issue of water for ordinary crops, as distinct from sugarcane cultivation, revision of water rates, and use of tail water by hydro-electric works.

Irrigation Board : meeting in Delhi from October 30. October 12, 1937.

Refers to the 8th annual meeting of the Centeral Board of Irrigation.

Hydro-Electric Schemes in Hyderabad : Industrial advance : Project to cost Rs. 65 Crores. October 12, 1937.

The Chief Engineer and Secretary to Nizam's Government for Capital Works, in a statement out-lined the possibilities existing in the State for the development of hydro-electric power. He gave a brief description of the several hydro-electric schemes that are to be developed in the State, numbering about ten in all. It is stated that from Godavary and Kistna rivers alone a continuous supply of 145,000 k. w. can be generated and about 70,000 from thre tributaries of these rivers. The total cost of all these schemes will amount to Rs. 65 crores, and it is expected that on an average a return of 8 to 10 per cent. will be realised.

Harnessing the Mighty Vogla : Soviet starts New Project : group of Huge Power Stations. October 14, 1937.

Preliminary work has begun on one of the Soviet's buggest enterprises, *i.e.*, the construction of a group of gigantic power-stations on the Samara Bund of the Volgra river. It is stated that their capacity will be 25,00,000 k. w. and their annual output of power will be about 1,40,00,000 kilowatts hours. The project provides for the erection of a dam 18 miles up the river which will raise the Volga 96 ft. The dam will form a reservoir more than 370 miles long. About 55,00,000 cubic metres of concrete will be used in its construction and from 25 to 30 million cubic metres of rock will be removed.

THE SON CANALS OF BIHAR : THEIR CONTRIBUTION TO WEALTH OF PROVINCE. October 18, 1937.

This is a Government of India Press Note. For notes see under Government of India publications.

CENTRAL PROVINCES GAZETTE. October 21, 1937.

Leave up to 16th of January, 1940, preparatory to retirment, is granted to Mr. H. A. Hyde, Chief Engineer, C. P. and Berar, P. W. D., with effect from the 16th of November 1937.

MADRAS GOVERNOR AT METTUR : THE EMPIRE'S BIGGEST DAM INSPECTED. October 21, 1937.

The Governor of Madras visited the Stanley Dam and the power stations. The first stage of the Mettur hydro-electric scheme, to generate 45,000 h. p. with three generating units, will be completed before the end of the year.

U. P. TUBE-WELLS : RS. 126 LAKHS OUTLAY ON SCHEME. October 22, 1937.

An official note on the U. P. Tube Well Scheme in the seven western districts of the Province where 1490 tube wells will be working next summer. The scheme commands an area of 1½ million acres and it is estimated that it will irrigate 625,000 acres in normal years and more than three quarters of a million acres in drought years. The capital outlay is estimated to reach 126 lakhs of rupees. The gross revenue will be Rs. 42 lakhs annually and the working expenses 33 lakhs.

FLOOD PROBLEM IN ORISSA : CONGRESS MINISTRY CONSIDERING MATTER. October 24, 1937.

The Ministry is in correspondence with the Government of India and other Provincial Governments and it is understood the appointment of an inter-provincial board to suggest measures to check the flood water of the river Mahanadi is under contemplation.

THE EASTERN GRID. October 26, 1937.

Editorial note on the proposed Eastern Grid Scheme in the U. P. The scheme is to pump water at two points on the Ganges to supply canals in Allahabad and Partabgarh districts ; to irrigate areas south of Allahabad from the river Tons ; and also from the river Gumti at Sultanpur. In Benares district tube-well irrigation is possible. Generation will take place in the hills either of Rewa State or the Mirzapur district and the power will be transmitted to Allahabad for distribution.

THE DEVELOPMENT OF WATER POWER IN TRAVANCORE : ELECTRICITY FROM THE HIGH HILLS : THE GREAT PALLIVASAL SCHEME DESCRIBED. October 29, 1937.

Describes the scheme and the progress in its construction. The scheme was started in 1933. The present programme is for the development of 9,000 k. w. from the falls in the Mudirapuzha river which is a tributary of the Periyar. Total head available is 1,990 ft. distributed over three miles. The ultimate designed capacity of the project is 22,500 k. w.

A diversion weir with collapsible shutters will be constructed at Munnar and water from the Mudirapuzha river will be diverted through an open channel of a length of about 1,500 ft. and led into a tunnel bored through the Nagamalai ridge. The tunnel is roughly over 10,200 ft. long and 9 ft. high. It is lined with concrete and at some places gunnite. From the tunnel exit water will be led down to the power house by means of two penstock lines 7,700 ft. long. From the penstocks the water will be admitted to three pelton wheels each generating 6,000 h. p.

Distribution and transmission system is also described. Out of a total ready load of 5,000 k. w. 500 will be utilized for lift irrigation and drainage.

JODHPUR WATER SCHEME : 60 MILE CANAL. October 29, 1937.

As the present water supply is insufficient, a scheme has been evolved by which the waters of an irrigation tank, known as Sumersammand, which is about 50 miles from the city but where rainfall is sufficient, will be transferred, by open channel flow, to a point within seven miles of the city. This canal will be concrete-lined and will cross the intervening river beds by means of siphons. It will be 60 miles long.

CAUSE OF MALARIA OUTBREAK : RIVER TO BLAME. October 30, 1937.

It is stated that the malarial condition in the Mymensingh district in Bengal is due to the Brahmputra becoming useless for flushing purposes. It is therefore concluded that in the interests of sanitation the channel of the Brahmputra with its branches should be improved.

CHEAP POWER FOR AGRICULTURE : CROPS AND SOILS SURVEY : BOARD OF IRRIGATION MEETING. October 30, 1937.

Gives briefly the important subjects to be discussed at the annual meeting of the Central Board of Irrigation which begins on October 30. The subjects include design of weirs, design of falls, flood control, equitable distribution of irrigation water, production of cheap electric power, river training, etc.

Built to protect Delhi : Karnal's History. October 31, 1937.

Narrates how Karnal cantonment was constructed and how it was finally abandoned. It is stated that the cantonment was constructed after the occupation of Delhi in 1803 in order to protect Delhi. But it had to be abandoned in 1843 because the Western Jumna Canal, which in pre-British days was only a seasonal canal, had been made a perennial one by British engineers and this had turned Karnal district into a swamp, giving rise to malaria which in turn caused an extraordinary high death rate among the troops.

Need for more Food Crops : India's Problem : how water resources may be developed. October 31, 1937.

Gives briefly the points mentioned in the note submitted by Mr. T. A Curry, Chief Engineer, Bengal, to the Central Board of Irrigation, on the subject " Policy of Irrigation in India, with particular reference to future development and finance ". The note outlines the various methods of developing water resources, danger of premature reclamation in deltaic and tidal areas, methods of soil improvement, etc.

Tube-wells at Panwaria : Nawab of Rampur performs Opening Ceremony. November 2, 1937.

Refers to the opening ceremony of the second series of tube wells installed as an experimental measure to further construction. The first series consists of 35 tube wells.

Completion of U. P. tube-well scheme : two new power stations opened by Governor : seventeen years' work provides cheap electricity and water : tribute to Sir W. Stampe : successful use of subsoil and canal reserves : small towns and mofussil area benefits. November 3, 1937.

The fifth and sixth of the series of seven canal-driven power stations at Chitaura and Salawa, provided under the Ganges grid project of 1935, were formally opened by the Governor of the United Provinces.

The main features of the whole scheme, which now has a gross output of 29,000 k. w. distributed by roughly 4,000 miles of transmission lines to some 1,600 sub-stations scattered over the eight western districts of U. P., are described. Over 40% of this output is employed for 1,490 tube-wells serving 600,000 acres.

U. P. TUBE-WELLS : CANAL FEEDERS OPENED AT SARDHANA. November 3, 1937.

The Governor of the U. P. performed the opening ceremony of 30 tube-wells, which pump roughly 100 cusecs directly into a canal. The construction of tube-wells as direct means of irrigation was not feasible in the area to be fed due to geological reasons. This additional water is being utilized mainly for irrigation on the Mat Branch.

IRRIGATION BOARD : WATERLOGGING MENACE : FLOOD PROBLEMS : SIR W. STAMPE TO ADDRESS TO-DAY'S MEETING. November 3, 1937.

Refers to the meeting of the Central Board of Irrigation commencing on October 30. Gives the list of officers who attended the meeting. Refers to the address to be delivered by Sir William Stampe on inter-provincial power development and gives the Board's decision regarding gauging of river discharges.

PLEA FOR CHEAP POWER : SIR W. STAMPE ON GRID SYSTEM. November 4, 1937.

Gives briefly the address of Sir William Stampe before the Central Board of Irrigation delivered on the subject of inter-provincial power development in India.

POWER FROM THE GANGES. November 4, 1937.
Editorial notes on the Ganges Grid Scheme.

HYACINTH PEST : OFFICIALS VISIT WORK OF CANAL RECLAMATION. November 4, 1937.

Certain Dacca officials visited the Arial *bil* in the Munshiganj sub-division to see the working of the water hyacinth control scheme that had been inaugurated in the area from the beginning of the year.

THE GANGES GRID : November 5, 1937.

Editorial notes on the scheme.

CENTRAL BOARD OF IRRIGATION : ECONOMIC PROBLEMS OF PROVINCES : CAN BE SOLVED BY CHEAP POWER : CO-ORDINATION OF NEEDS SUGGESTED : SIR WILLIAM STAMPE'S ADVICE ON DIFFERENT SYSTEMS. November 5, 1937.

Gives Sir William Stampes address on inter-provincial power development delivered before the Central Board of Irrigation.

FLOOD PROBLEMS DISCUSSED : WATERLOGGING AND LAND RECLAMATION : CENTRAL BOARD IN SESSION. November 5, 1937.

Mentions some of the subjects discussed at the meetings of the Central Board of Irrigation.

MR. M. R. RICHARDSON ELECTED PRESIDENT FOR NEXT SESSION. November 5, 1937.

Mr. M. R. Richardson, C.I.E., Chief Engineer, U. P., was elected President of the Central Board of Irrigation for the ensuing year.

METTUR DAM NOT IN DANGER : RECENT TREMORS : N. INDIA EARTHQUAKES THE CAUSE. November 7, 1937.

See under Government of India publications.

ELECTRIFYING TRAVANCORE : WHAT THE PALLIVASAL PROJECT MEANS. November 5, 1937.

Describes briefly the project. See also news dated October 29, 1937.

DAWN OF A NEW INDUSTRIAL AGE IN U. P. : OPENING OF GANGES GRID SCHEME. November 8, 1937.

An illustrated article by Sir William Stampe describing briefly the history and main features of the scheme.

ARTESIAN WELL : BORING EXPERIMENTS IN BHARATPUR. November 8, 1937.

At Bharatpur a tube-well has been sunk which has yielded results with all the characteristics of an artesian supply. During the boring operations a stratum of clay and kankar was encountered down to 330 ft. Immediately below this came sand and gravel down to 354 ft. exactly similar to that which might be found on the bed of any river and from this surged up clear, apparently potable water to a height of 9 ft. from ground level yielding 900 gallons per hour. By means of a compressor and pump this natural flow has been increased to yield 12,000 gallons per hour. Experiments are still proceeding.

NEW GOVERNMENT DEPARTMENTS : START OF WORK. ALLOCATION OF SUBJECTS : LABOUR SCOPE. November 8, 1937.

The existing Departments of Commerce and Railways, and Industries and Labour have been reshuffled and in their place have been created the Departments of Commerce, Labour and Communications. The subjects under each department are given, also the names of officers of each department. Irrigation has been placed under the department of Labour.

LETTER TO THE EDITOR : IRRIGATION IN BENGAL.
November 9, 1937.

This is a letter from Mr. H. B. Saxby. He says that just as tube-well irrigation has been a success in the U. P. there is every possibility of its proving equally successful in those areas of Bengal which are not being served by open canals. He says that although hydro-electric power may not be feasible, electricity on rates comparable to U. P. can be produced from coal, for the Province has abundance of coal fields.

INDUSTRY IN GWALIOR : CULTIVATION AND IRRIGATION.
November 10, 1937.

This is an article by Sir Kailash Narain Haksar, C.I.E., B.A. He gives in general the condition of Gwalior in respect to industry, cultivation and irrigation, and the possibilities of future development.

FLOOD CONFERENCE IN PATNA : NEED FOR CO-OPERATION BY ALL GOVERNMENTS : BIHAR GOVERNOR'S SPEECH.
November 12, 1937.

The Flood Conference, convened by the Bihar Government in order to devise ways and means to tackle the flood problem and formulate a policy to deal with it, was opened by the Bihar Governor and was attended by officials, non-officials and experts of Bihar, Bengal, U. P., Nepal and Hyderabad State. The problems was discussed in all respects and the need of co-operation of the Provinces and States affected was stressed.

INDIA'S IRRIGATION PROBLEMS : RESEARCH NEED : DECISION OF CENTRAL BOARD. November 13, 1937.

Gives the subjects discussed at the annual meeting of the Central Board of Irrigation. One of the subjects discussed was the necessity of a Central Research Station for Irrigation and Sir John Russell's recommendations in this respect were also examined.

RAJEN BABU'S ADDRESS. November 14, 1937.

Gives the gist of Babu Rajendra Prasad's address before the Flood Conference. He said the problem of floods, irrigation and malaria needed a comprehensive solution and this required scientific investigation first.

EMBANKMENTS TO BE REMOVED : RESOLUTION PASSED BY FLOOD CONFERENCE. November 14, 1937.

The Flood Conference passed a resolution stating that the damage caused by floods was usually aggravated by embankments, which should be removed after an enquiry into their merits individually, and the existing waterways, roads and railways enlarged and increased where necessary. New embankments should be constructed only in exceptional cases. The Embankment Act should be amended in order to provide constitution of a Flood Committee to advise the Government on flood problems.

SETTLING IRRIGATION RATE : COMMITTEE TO DECIDE POLICY. November 14, 1937.

It is understood the Government of Bombay have decided to appoint a Committee of four officials and five non-officials to go through the policy of the government regarding irrigation rates of water supply, etc.

ELECTRIFICATION OF BIHAR : U. P. OFFICIAL'S EXPERIENCE November 15, 1937.

Sir William Stampe may be invited by the Bihar Government to advise the government on the possibilities of extending electrification to rural areas. Sir William recently expressed the opinion that electricity could be produced cheaply from coal power in the province.

IRRIGATION RESEARCH STATION AT POONA : FUTURE DISCUSSED : NEW CENTRAL INSTITUTE AT DELHI. November 15. 1937.

Gives the gist of discussion of the Central Board of Irrigation on the subject of an all-India Research Station for Irrigation. The Board decided that there should be a Central Station and that it should be somwhere near Delhi, and further that it should be financed by the Government of India.

FLOOD PROBLEM IN BIHAR : NEPAL RIVER POLICY. DIVERSION AT SOURCE CRITICISED. November 16, 1937.

Describes the suggestions and discussion put forward at the Flood Conference. One of the sources of floods was stated to be Nepal Government's Constant diversion of the flow of water from one river to another which causes heavy flooding in particular rivers.

EXPANSION OF U. P. GRID : CHEAP POWER FOR RURAL AREAS : LINKING OF PROJECTS : SIR WILLIAM STAMPE ON FUTURE PROGRESS. November 23, 1937.

This is a speech of Sir William Stampe at a meeting of the U. P. Centre of the Institution of Engineers, India, in which he discusses briefly the steps required for the consolidation of the electrical position in the U. P. as it stands today, and the measures that must be takon for the further development of the situation.

Naini Tal lake leakage fears : Committee Report : Hydro-electric system not in danger. November 25, 1937.

A technical committee was appointed to report on the capacity of the lake to meet the demands of hydro-electric supply in view of leakage from the lake, the movement of hillsides, etc. Their report dispels any fear of the breakdown of the hydro-electric system. It is recommended by the committee that an Executive Engineer should be in single charge of the Division to give his full time for the protection of hillsides.

Control of Water Hyacinth : new Bengal Scheme. November 26, 1937.

A new and scientific scheme for the eradication of water hyacinth has been innaugurated in the Arial *bil* in Decca district. The scheme consists in the erection of barricades. The alignment of one line of barricade is made across the direction of the prevailing wind. The masses of water hyacinth driven by high winds move towards the barricade and being obstructed in their progress are deflected into the *khals* of Ichamati and thence into the Dhaleswari and the Padma, and ultimately to the sea, to be finally destroyed there by saline water.

Engineering triumph : Lloyd Barrage Benefits : Sind transformed deserts that are now " Smiling Fields ". November 26, 1937.

See under Government of India publications.

Karachi Canals Division : improvements in water supply. November 26, 1937.

An official statement on the improvements made to make good the deficiency of water caused to the Karachi Canals Division zamindars by the off-taking of water higher up in the Indus.

Generating electric power : feasibility of Tando Mastikhan Falls. November 26, 1937.

That Tando Mastikhan Falls, being of low head—only 10 ft.—are not serviceable for producing hydro-electricity is the view which appears to have been expressed by the Chief Electrical Adviser to the Sind Government.

Construction of walls and ceilings : treated Timber best materials. November 26, 1937.

Some notes on a pamphlet on the subject issued by the Forest Research Institute, Dehra Dun, claiming treated wood to be the best material for walls and ceilings.

OFFICIAL VIEW UNDULY OPTIMISTIC : MR. GAZDAR ON BARRAGE SCHEME : " ESTIMATION CAN NEVER BE REACHED ". November 27, 1937.

Mr. Gazdar, a member of the Reorganization Committee of the Sind Government, has submitted a note to the committee making a case for a reduction of Rs. 25 lakhs in the expenditure of the Public Works Department as he thinks that the estimated figure of 54 lakhs of acres of ultimate cultivation cannot be reached. He says that this estimation was based on the assumption of an intensity of cultivation of 81% (27 kharif and 54 rabi) but this has only been 24·09 and 10·83 respectively.

THE JUMNA MISBEHAVES : DELHI INVITES ADVICE FROM POONA. November 28, 1937.

Several years ago the Government of India established a pumping station, for irrigating the winter capital, on the right bank of the river about half a mile below the Red Fort. After flowing for many years close by this pumping station, the river has changed its course about a third of a mile away. As the water supply for New Delhi gardens depends entirely on this pumping station the government had to construct a channel from the new stream to the pumping station. They have also built three training bunds on the left bank but these bunds are interfering with several miles of training bunds constructed by the U. P. Government for diverting water towards Okhla Weir six miles below. The Poona Research Station has been asked for advice and they are now conducting model and other experiments.

POWER FOR 12,000,000 : METTUR'S HYDRO-ELECTRIC DEVELOPMENT. November 28, 1937.

First stage of the Mettur Hydro-Electric scheme has been completed. Gives in brief the features of the scheme.

PUNJAB DRIVE FOR MORE REVENUE : INQUIRY AFOOT : SUGGESTIONS INVITED FROM PUBLIC. December 1, 1937.

The Punjab Resources and Retrenchment Committee has issued a comprehensive questionnaire inviting suggestions for means by which the revenue of the Province may be increased. Modification of the water rates is one of the questions. It is also asked if the sale of water by volume could be advocated for increasing revenue.

REPAIRING DAMAGE : RECONDITIONING OF ANDERSON WEIR. December 1, 1937.

See page 13 of Quarterly Bulletin No. 7.

COMPLAINTS AGAINST PUBLIC WORKS DEPARTMENT : "INADEQUATE WATER SUPPLY AND UNSYMPATHETIC OFFICERS" : DR. HEMANDAS R. WADHWANI'S IMPRESSIONS OF HIS TOUR. December 3, 1937.

The Public Works Minister, Sind, made a tour in the Province and has collected opinions of zamindars regarding problems of seepage, widening of modules, repairs of minors, etc. He finds divergence of opinion between zamindars and officials. He will report the complaints of zamindars to the Secretary, Public Works Department for eliciting opinion of departmental staff. Then he will call a conference of zamindars and decide changes to be effected.

BIHAR DEVELOPMENT : SIR W. STAMPE'S VISIT TO PATNA. December 4, 1937.

Sir William Stampe is visiting Bihar to discuss the possibility of electrification in Bihar.

TUBEWELL IRRIGATION : PUNJAB MINISTER VISITING U. P. December 5, 1937.

The Punjab Minister in charge of the P. W. D. is visiting the U. P. tube well scheme to study its practical working with a view to introducing this system in the Punjab.

WHERE RIVERS GO TO SCHOOL : IRRIGATION RESEARCH STATION'S PROJECTED MOVE TO DELHI. December 5, 1937.

Gives a brief description of some of the river training experiments conducted at the Poona Research Station and mentions that it has been proposed to move the Station to Delhi.

CURRENT TOPICS : VALUE OF RESEARCH. December 5, 1937.

Emphasises the value of research by mentioning the advantages gained from certain experiments conducted at the Punjab Irrigation Research Institute and the Poona Research Station.

RIVERS OF INDIA—NO. 2 : THE GODAVARI AND ITS RELIGIOUS SIGNIFICANCE. December 5, 1937.

Describes the Godavari river with reference to its religious sanctity.

SIR W. STAMPE : DISCUSSING WITH BIHAR OFFICIALS. December 6, 1937.

Sir William Stampe discussed the possibility of rural electrification with Bihar officials. Discussion was mainly confined to a general survey of the possibility of the proposed scheme which experts now believe to be practicable.

Irrigation Link : Phalton-Baramati Road to be improved. December 7, 1937.

The designs of a bridge over the Nira river, a road and drainage works for joining the irrigation tracts of the Nira Right Bank and Nira Left Bank Canals between Phalton and Sangavi, are now in hand.

Punjab's progress in Agriculture : needs of Provinces. December 7, 1937.

The Second Meeting of the Crops and Soils Wing of the Board of Agriculture and Animal Husbandry in India was opened by the Punjab Governor. The agenda of the meeting included the subject of water requirements of crops in which irrigation engineers are interested.

Spanning the Meghna. December 8, 1937.

This is an editorial note. It is stated " the opening of the new bridge over the Meghna river marks not only the completion of a fine engineering feat but a notable development of the communications between Bengal and Assam ". The remarkable engineering feature of this structure is that the pier caissons have been sunk in 65 ft. of water, which is stated to be the greatest depth in which well sinking has been attempted in India. The bridge has been built with Indian cement, Indian steel and Indian labour.

Flood relief in Orissa ; statement of work by Government. December 9, 1937.

This is a Government communiqué which gives the relief measures undertaken in connection with the floods in the Mahanadi river and its branches.

Rivers of India—No. 3 : the Indus " Father of Indian Rivers ". December 12, 1937.

This is an article by K. Satthianadhan. It gives a general history of the river. Mention is also made of the Sukkur Barrage Project.

President " Climate Conditions " his country : mountain air for Polish cabinet meetings. December 12, 1937.

Prof. Ignatius Moscicki, the present President of the Polish Republic, is also a world authority on chemical engineering. He has constructed an apparatus which produces artificial mountain air, *i.e.*, not only cleanses the air of any given locality but supplies it with the tonic and curative qualities which make mountain air health-giving, bracing and refreshing.

CANAL DUES : COLLECTION SYSTEM IN SON AREA CHANGED. December 15, 1937.

A new system known as the " modified central system of collection " has been introduced as an experimental measure in four collection circles of the Son Canals in Bihar. Under this system tehsildars instead of peons go direct to the rate-payers for collection.

NEW POWER SCHEME : MINISTER'S INSPECTION OF SITE IN TINNEVELLEY. December 15, 1937.

The Public Works Minister, Madras Government, inspected a site for a hydro-electric reservoir in the Papanasam hills in Tinnevelly district for supplying electricity for industrial and other purposes in Tinnevelley district and adjoining areas where there are many cotton and other mills. Definite proposals have now been made and the scheme is estimated to cost Rs. 2½ crores.

AGRICULTURAL RESEARCH IN SIND : SUB-SURFACE INVESTIGATION SCHEME. December 16, 1937.

An important meeting of the committee appointed by the Imperial Council of Agricultural Research to work out a scheme of sub-surface investigation in the Lloyd Barrage area was held in Karachi. The committee suggested that in addition to the work already being carried out by the Sind P. W. D. the work of the estimation of clay fraction should also be undertaken. They also suggested that the work of exchangeable bases, total base saturation capacities, availability of food material and the distribution of soil colloids in different horizons of a complete soil profile should also be undertaken.

CANAL LOSSES : U. P. IRRIGATION EXPERIMENTS. December 17, 1937.

Gives some of the subjects on which experiments will be carried out in U. P. during the year 1937-38. For full programme of research work in the U. P. see pages 2 to 4 of the last Bulletin.

NEW SCHEMES OF RESEARCH : GRANTS SANCTIONED . APPROVAL OF REPORTS OF BRITISH EXPERTS. December 17, 1937.

Grant of Rs. 6 lakhs has been given for carrying out certain schemes of agricultural development and live-stock improvement as suggested by Sir John Russell and Dr. N. G. Wright.

A scheme to decide the water requirements of crops is also to be tried at Lyallpur. This scheme is not an irrigation investigation but is to determine how much water crops need in different conditions of growth.

SOIL RESEARCH : PROGRAMME OF POONA EXPERIMENTS.
December 21, 1937.

For full programme of research of the Irrigation Research Division, Poona, see page 4 of last Bulletin.

SALT MOVEMENTS IN SOILS : PUNJAB RESEARCHES : IRRIGATION INSTITUTES PROGRAMME FOR 1938.
December 22, 1937.

For full programme of the Punjab Irrigation Research Institute see pages 5 to 11 of the last Bulletin.

PUNJAB IRRIGATION PROBLEMS : 12 YEARS' WORK.
December 26, 1937.

A brief review of the most important subjects investigated at the Punjab Irrigation Research Institute since its establishment in 1925.

CENTRAL RESEARCH INSTITUTE : LAHORE'S CHANCES.
December 30, 1937.

States Punjab Irrigation Research Institute's chances, as compared with the Poona Research Station, of being made an all-India Research Station.

SCIENCE CONGRESS JUBILEE : VICEROY TO PRESIDE.
December 30, 1937.

IRRIGATION POLICY IN BOMBAY : ASSESSMENT AND WATERLOGGING PROBLEMS. December 31, 1937.

The Bombay Government have appointed a committee, with Sir N. Visweswaraya as Chairman, to examine the Government's irrigation policy. The terms of reference are :—

(1) What should the general irrigation policy of the government be as regards supply of water to owner irrigators, tenant farmers and industrialised undertakings; also in regard to the supply of water for non-agricultural purposes, *e.g.*, water for municipalities mills, railways, etc.

(2) If the present policy is suitable, is any revision of water rates and canal rules necessary, taking into consideration the cost of water and value of different crops ?

(3) If any other policy is recommended, what should be the basis of assessment on account of irrigation facilities provided ?

(4) What steps should be taken in the case of lands in villages damaged by waterlogging ?

M. T. GIBLING,
Secretary,
Central Board of Irrigation.

MSCBI—1,200—8-2-38—GIPS

GOVERNMENT OF INDIA

CENTRAL BOARD OF IRRIGATION

QUARTERLY BULLETIN NO. 9.

JANUARY TO MARCH 1938.

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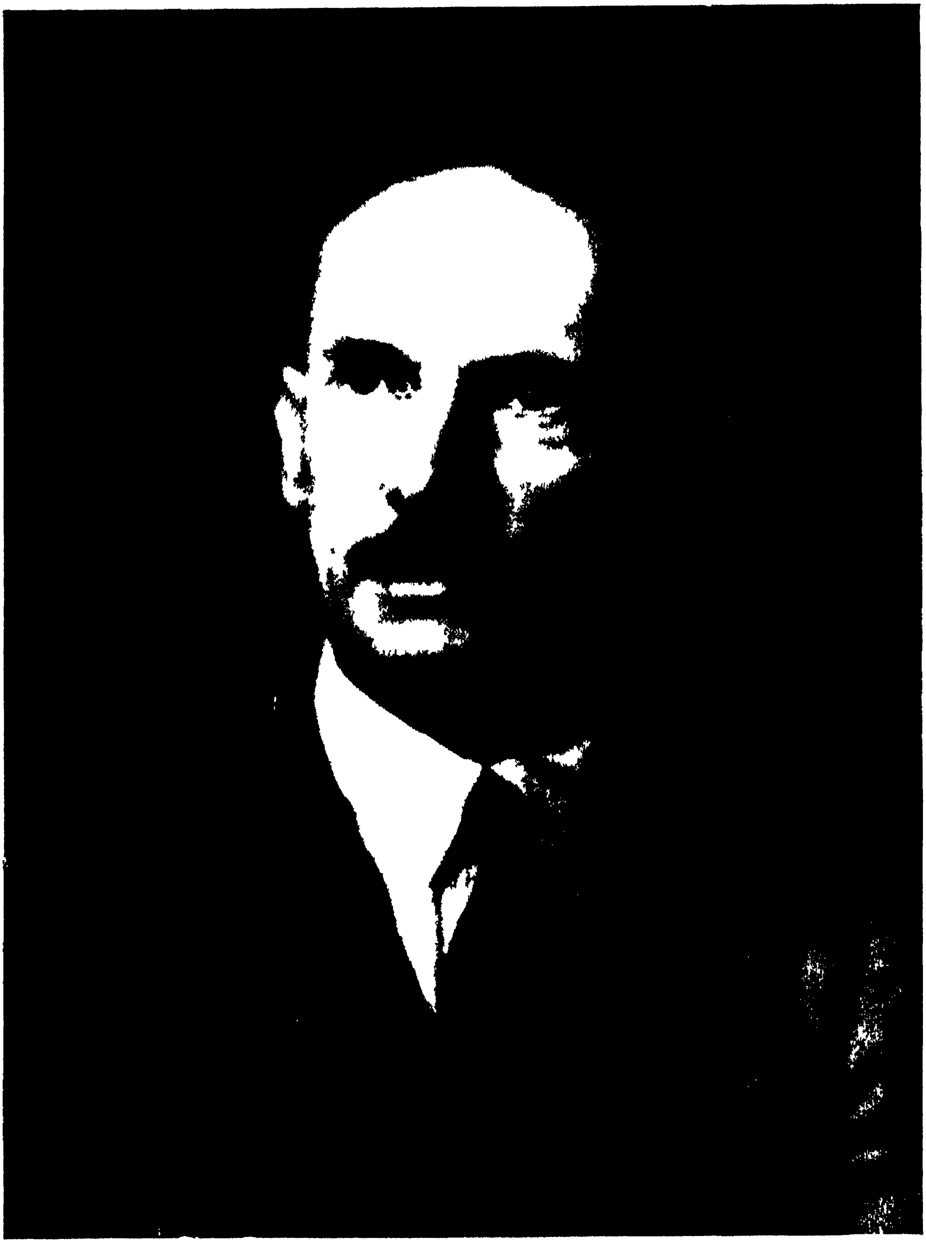
SIMLA,
15TH APRIL, 1938

The Government of India and the Central Board of Irrigation are not responsible for the statements made or opinions expressed herein.

PRESIDENT

1937-38.



Mr M R Richardson, C I.E , I S.E., Chief Engineer (Western Canals), United Provinces.

CHANGE OF ADDRESS.

The address of

SECRETARY
CENTRAL BOARD OF IRRIGATION

is now

"Sherwood"
Simla W. C.

The Board.

1. The following changes in the Membership of the Board have taken place or are anticipated :—

Mr. T. A. Andrew has proceeded on leave preparatory to retirement and Mr. N. B. Baxter has succeeded him as Chief Engineer and Secretary to Government of Bombay, P. W. D., Irrigation and Railways.

Mr. S. H. Bigsby, C.I.E., Chief Engineer (South) and Secretary to Government, Punjab, will proceed on leave on or about the 5th May 1938, and Mr. E. O. Cox, M.B.E., will officiate in the post.

Mr. G. M. Ross, C.I.E., Chief Engineer and Secretary to Government, N.-W. F. P. (past President of the Board) is proceeding on leave preparatory to retirement from the 9th of April and Mr. A. Oram will succeed him.

Mr. T. A. Curry, Chief Engineer, Bengal, is proceeding on leave preparatory to retirement and will be succeeded by Mr. S. C. Majumdar.

2. Mr. A. R. B. Edgecombe, Executive Engineer and Research Officer, U. P., has been selected as Secretary, Central Board of Irrigation, for four years from 1st May 1939, when the tenure of the present Secretary terminates.

3. The Office of the Board in Simla has been moved from the "Central Telegraph Building" to "Sherwood", near Gorton Castle.

Research Committee.

1. Mr. A. R. B. Edgecombe, Executive Engineer and Research Officer, U. P., has proceeded on leave and he has been succeeded by Mr. B. N. Khatri, I.S.E.

2. An informal meeting of the Research Committee of the Board was held in Lahore from the 17th to the 19th February 1938 at the time of the annual meeting of the Punjab Engineering Congress. The following officers attended :—

Mr. M. R. Richardson, C.I.E.	President of the Board.
Mr. E. S. Crump	Officer on Special Duty (Research), Punjab.

Mr. C. C. Inglis, C.I.E.	Director, Central Irrigation and Hydrodynamic Research Station, Poona.
Dr. N. K. Bose	Officiating Director, Punjab Research Institute.
Rai Sahib Kanwar Sain	Haveli Central Designs, Punjab.
Mr. E. A. Moore	Officer on Special Duty, Development Projects, Bengal.
Mr. A. R. B. Edgecombe	Research Officer, United Provinces.
Mr. J. Shaw	Officer on Special Duty (Floods), Orissa.
Mr. U. N. Mahida	Research Officer, Bombay.
Mr. J. M. Macintyre	Executive Engineer, Baluchistan.
Mr. A. R. Thomas	Executive Engineer, Central Irrigation and Hydrodynamic Research Station, Poona.
Mr. H. S. Kahai	Research Officer, Sind.
Mr. M. T. Gibling	Secretary, Central Board of Irrigation.
Mr. J. N. Mitra	Assistant Secretary, Central Board of Irrigation.

At the invitation of the Honorary Secretary, Punjab Engineering Congress, the Committee attended the annual meeting of that Congress, at which several interesting papers were read and discussed. On Friday, the 18th February the Committee visited Malikpur and Madhopur on the Upper Bari Doab Canal, and also inspected several other interesting works *en route*. At Malikpur, Dr. Bose explained the experimental work in hand on models of several works, including different designs of falls, a silt excluder and a bridge for the Haveli Project. Another very interesting model was that of the proposed Trimmu Weir with a length of the Chenab and Jhelum Rivers, on which a number of problems connected with the Haveli Project headworks were being investigated.

On Saturday morning (19th February) the Committee attended the final session of the Congress, and then proceeded to the Punjab Irrigation Research Institute, where Dr. Bose and his staff explained the various experiments in progress. These included model experiments on the reconstruction of Islam Weir, seepage from canals, a small scale model of the Trimmu Weir, river training above Islam Weir on the Sutlej river, tube well experiments, and investigations on the transmission coefficients of soils.

An informal dicussion was held in the Punjab Secretariat on Saturday afternoon, and the following subjects were discussed :—

Backwater curves.

Tube wells.

Canal losses.

Time factors in models.

Canal falls.

Meandering of Rivers.

Run-off for Surface Drains.

The following resolution in connection with Canal Falls was passed by the Committee :—

Resolution.—This Committee recommends to the Board that the Punjab Government be invited to consider the question of constructing three or four falls of different design on one of the channels of the Haveli Project. As far as possible the conditions for all the falls should be identical. The design of canal falls has been discussed by the Board and its Research Committee for several years, but up to date no decision has been reached as to the best design, and although experiments with models have assisted considerably with this problem and have produced designs which can be relied upon, further progress can only be achieved by constructing the prototypes. This would also provide an excellent opportunity for studying the behaviour of models as compared with their prototypes.

Mr. Kanwar Sain exhibited the designs of the proposed Trimmu Weir (Haveli Project) and explained them to the Committee, and an interesting discussion followed. He also exhibited and explained the design of the brick tile lining to be adopted in a length of 45 miles of the Main Canal.

Mr. Crump rendered the Committee valuable assistance during the inspection of works on the 18th, and during the discussions on Saturday the 19th.

The Committee resolved that the meeting had been of considerable value to the officers present, and recommended its continuance in the future.

2. The following new subjects which were approved by the Board for investigation will be considered by the Research Committee at the next annual meeting which will be held at the end of June or beginning of July :—

(*i*) The collection of hydraulic data of torrents in boulder rivers and stream.

(*ii*) Silt excluders and ejectors.

(*iii*) The preparation of a guide to the collection of statistics for irrigation.

Board Publications.

1. The revised edition of the "Glossary" (Publication No. 5) is still under preparation.

2. Mr. C. C. Inglis is revising his note entitled "Instructions for designing Standard Standing Wave Flumes" before publication by the Board.

3. Publication No. 12 entitled "Design of Weirs on Permeable Foundations" is undergoing final printing. Copies will be distributed shortly.

4. The question of placing Mr. Gerald Lacey on special duty to write a Board publication on his theories for the design of channels in alluvium is still under consideration.

5. The Research Committee will discuss at its next meeting the question of publishing Mr. C. C. Inglis' report on his experiments with the design of Canal Falls.

6. The Annual Report (Technical) of the Board for 1936-37 is in the press and copies will be distributed shortly.

Works Section.

PUNJAB.

Lining of Haveli Main Canal.

An important feature of the Haveli Project now under construction in the Punjab is the lining of the main canal for a length of about 45 miles with a special type of brick tile lining. The lining of the main canal in the head reach, in addition to prevention of waterlogging, will mean a saving of 250 cusecs of water which would otherwise have been lost by percolation into the subsoil. The approximate cost of the lining will be about Rs. 55 lakhs but the net additional cost will be about Rs. 14 lakhs in view of the small section of the canal necessary, resulting in savings in works and land, and other savings.

The type of lining finally decided upon was evolved after experiments and investigations with various types. The experiments are still in progress and an interim report of the investigations carried out so far has been given in a note by Mr. F. F. Haigh, Superintending Engineer, 1st Circle, Haveli Project. A summary of the note is included under the literature section of this Bulletin.

UNITED PROVINCES.

Remodelling of the Mat and Hathras Branches of the Upper Ganges Canal.

An interesting work which is now nearing completion is the remodelling of the Mat and Hathras Branches on the Upper Ganges Canal in the United Provinces. The original Mat Branch was built by Cautley about the middle of last century, being opened for irrigation in 1854. It was extended in 1908, and again in 1912, when the Hathras Branch taking off from Mile 46 of the Mat Branch was constructed. About the year 1928 it was found that insufficient water was available on the Mat and Hathras Branches. Larger supplies were forced into the Mat Branch by eliminating the falls and thus increasing the surface slope. The discharge increased from 1150 to 1350 cusecs. The

Village Road Bridge combined with 1 foot fall at Mile 38 1 13 Mat Branch, which replaces a drowned foot bridge Bridge arches were raised, roadway widened, approaches were flumed and the crest set back.

Head of Hathras Branch.—The 7 spans contain 2 extra ones to take in 670 cusecs Note Griffiths cill and the divide wall with a cut water riding on the cill.

increased slope, however, scoured away the berms and widened the channel and as the masonry works were not enlarged due to lack of funds full, supply levels rose, and endangered the safety of the canal. Waterlogging occurred in some areas due to greater seepage, which was attributed to the increase in water depth and the scouring away of the silt berms. Heavy expenses were incurred in maintenance, and although sufficient water was available in the upper reaches of the Mat Branch, the lower reaches and Hathras Branch suffered from shortage of supply and inequitable distribution. At the end of 1935 an extensive survey of the system was made and comprehensive proposals and estimates were framed for remodelling it. The designs were based on a discharge of 1700 cusecs at the head of the Mat Feeder and 667 cusecs at the head of the Hathras Branch, and Lacey's regime theory was adopted for the design of the channels. In remodelling the masonry structures several methods were employed, depending upon the peculiarities of each case. Some bridges have been flumed, while others have had their arches raised and additional spans added. The bridges combined with falls were nearly all flumed (see photograph opposite page 4). Large syphons were flumed by means of reinforced brick pitching, and the small ones consisting of one arched barrel were merely extended. The head of the Hathras Branch was enlarged by adding two spans. The Griffith's silt excluding cill which was already provided was slightly modified. (See photograph on the opposite page). As the area under irrigation will be increased, from 1·0 and 1·3 lac acres to 1·5 and 2·0 lac acres for kharif and rabi respectively, or from 2·3 lac acres to 3·5 lac acres annually, the total cost of the remodelling estimated at Rs. 9,24,934, is expected to be paid off in a few years. It is ascertained that the work had been practically completed by October 1937 and that the irrigation for one *fasl*, that of Rabi 1937-38, alone has exceeded 2·1 lac acres which is well above the figure proposed in the remodelling, and represents an increase of 60 per cent. over the pre-remodelling figures. (Full report is also available and is mentioned under " Literature Section " in this Bulletin.)

Information Bureau and Library.

1. The following are some of the enquiries dealt with during the quarter :—

Rock-fill dams.
Irrigation in South Africa.
Canal linings.
Weir shutters.
Drains in irrigated areas.

2. From the 1st of May the Board's library will remain open until 7 p.m. every evening except Sundays and closed holidays so that officers residing in Simla or visiting Simla on leave or on duty may make use of it as a reading room outside office hours.

Miscellaneous.

1. The Punjab Irrigation Department have appointed a committee to standardise the practice of remodelling of channels and outlets, and a questionnaire on the subject has been issued to selected officers. The committee will

submit its report by the end of April after considering the replies to the questionnaire.

2. The Foundation Stone Laying Ceremony of the Headworks at Trimmu (Haveli Project) was performed by H. E. the Governor of the Punjab on the 10th of February 1938. The structure across the river will be known as " The Emerson Barrage ".

A brief note on the design of this Headworks was given in the last Bulletin. The design of the weir has now been completed and construction of the weir section has commenced. It is reinforced for hydrostatic uplift, and as a raft for the load of the piers and superstructure.

The design of silt excluders and the right and the left undersluices has further advanced. The left undersluices have been split into two parts with a central divide wall. The left half will form a silt excluder having four tunnels with a paved approach and 280 ft. long divide wall, and the remaining four bays, *i.e.*, the right half of the undersluices, will consist of normal section.

For the right undersluices a Khanki type silt excluder will be provided covering one bay of the sluices.

Silt extractors or ejectors will be provided in both canals.

Another notable feature of these works is that there will be no stone masonry at all. All the superstructure will be built in thin precast 1 : 2 : 4 concrete shells, with a hearting of cheap concrete, thus eliminating all expensive dressing and extra cost of building stone. The divide walls and the flank walls will be of similar construction, and of economical section, partly gravity and partly reinforced.

In the design of masonry works on the canals, full use of R. C. is being made to ensure economy. The piers of road bridges will be made of R. C. trestles, and decking in R. C. T-beam construction, thus light and durable structures will be provided.

The work on the Project as a whole is progressing satisfactorily. About twenty thousand labour are employed on the various works of the Project.

3. Mr. J. D. H. Bedford, Chief Engineer (Construction) Punjab has accepted the recommendation of the Research Committee (as per Resolution passed at its informal meeting held in February) regarding the construction of alternative types of falls on the Montgomery-Pakpattan Link. A Montagu type, a Central Designs type No. 1, and an Inglis type of fall will be constructed for the purposes of comparison of cost and efficiency. Models of these falls are to be constructed, and some interesting information is expected from observations on the models and their prototypes.

4. A coal tar paint known as " Khanki mixture " is used extensively in the Punjab for iron and steel works which are in contact with water. The composition of 1 cwt. of the mixture is—

Coal Tar ..	84 lbs.
Mineral Pitch	10 lbs.
Slaked White Lime	9 lbs.
Kerosine Oil	9 lbs.

The method of preparing it is as follows :—

Heat the tar and pitch separately; mix them together over a fire, stir well and add the slaked lime gradually while stirring; then withdraw from the fire, and add the kerosine oil, stirring well. Care should be taken to see that the mixture is not overheated ; 350 to 450 degrees Fahr. is the correct temperature. The pitch scales off if the mixture has been burnt.

The average covering capacity of the mixture is about 2,500 sq. ft. per cwt. Two or three coats are sufficient. The surface to be treated should be cleaned and thoroughly dried and the mixture should be applied hot as soon as the surface is cleaned. Too much stress cannot be laid on this point as the mixture does not adhere or spread down in fitted portions of the surface if it is cold. Subsequent coats should be given only after the previous ones have dried. This mixture requires renewal every year or at the least every second year. Work thus painted should not be immersed in water until it has thoroughly dried ; one week is generally enough for this purpose.

The cost of painting with this mixture is Rs. 1-5-0 per 100 sq. ft. for 2 coats, excluding cleaning.

A Sub-committee has been formed by the International Commission on Large Dams to advise as to the lines on which an investigation into the design of earthen dams should be undertaken. Sir Bernard Darley who is the Board's honorary representative on the Commission is a member of the Sub-committee. The Board has proposed the following resolution for the consideration of the Sub-committee--

Resolution.—That each National Committee be invited—

1. To draw up a list of important Earthen Dams of not less than 80 feet in height, giving in each case a diagram showing the cross section of the dam and also details of the foundations, core, drains, benching and berms. The nature of earth used, method of construction employed and preparation of foundations should be described, and particulars should be given of any local conditions which affected the design or method of construction.
2. To supply similar information regarding important dams of 30 feet or more in height on which serious breaches or slips have occurred, and where possible, to analyse the causes of these.
3. To prepare diagrams showing the cross sections considered generally suitable for large earthen dams where the earth is (*a*) a light sandy loam, and (*b*) a moderately good stiff loam approaching the consistency of a clayey soil, and to state the maximum height to which dams of those materials can be reasonably safely built.

LITERATURE.

The following literature was received during the quarter.

Readers are reminded that they are at liberty to borrow any of the literature in the Board's library, in accordance with the rules published in Bulletin No. 3, and to submit enquiries on any matter dealing with irrigation and allied subjects.

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CIVIL ENGINEERING AND PUBLIC WORKS REVIEW

VOL. XXXII.

No. 378—December 1937.

FOREIGN NOTES.

DEVELOPMENT OF THE RIVER RHONE.

A state controlled company has been formed to undertake the planning and execution of extensive development works on the River Rhone. The organisation of the company and the preliminary investigations for the Genissat Power Station are described in *Ganie Civil,* 111, 365. The total fall of the river from the Swiss frontier to the sea is 1080 ft. and it is proposed to utilise this fall to develop power in 20 plants, 7 above Lyons and 13 below. The total available power will be 1,000,000 k.w. Work has been commenced on the construction of a dam and power station at Genissat. The dam will be a concrete gravity dam curved in plan, and 328 ft. high. It will form a storage reservoir of 1,830,000,000 cu. ft. capacity. There will be two power houses one on either side of the valley. Each power house will have four vertical shaft Francis turbine units. Work is now in progress on the two diversion tunnels each 33 ft. diameter one on either bank. These are concrete lined throughout. The intakes to the tunnels were designed with the aid of experiments on models.

THE RIO NEGRO HYDRO-ELECTRIC SCHEME. Borkenstein.

A hydro-electric scheme for developing the Rio Negro River in Uruguay has recently been approved by the Government. The scheme consists of a concrete dam across the valley having a power house situated at its toe on the right bank of the river. The dam will be of the multiple arch type, the thrust being taken by buttresses which in turn bear on a continuous foundation slab. Bonding with the underlying rock will be secured by grouting with cement. The dam will have an overall length of 1174 metres, about 800 metres of which consist of the multiple arch section, the remainder being of normal gravity type embankment. The arch section embraces a spillway section, a non-spillway section and a section with four turbine intakes. A general site plan showing the location of the dam and cross sections of the various sections of the dam are given. The spillway section is capable of dealing with 4450 cu. m. of water per second through 12 bays each having a clear width of 12, 5 m. fitted with a tainter gate 5 m. high. The downstream protection consists of an apron placed 4 m. below the surface of the river. The design of the spillway section and the apron was exhaustively tested by means of models in the hydraulics section of the Technical Academy in Berlin. The power station will contain four similar generating sets, each consisting of a vertical Kaplan turbine. Below the power house a transformer station will be located from which will start the overhead transmission lines to Montevideo. It is planned to provide for a national grid in the future for supplying power throughout the country.

ROAD FOUNDATION PROBLEMS.

A new road is being constructed by the Surrey County Council which includes a new reinforced concrete arch bridge across the river Mole. The country is chalky and when excavation for the foundations of the abutments of the bridge were completed it was revealed that several soft patches consisting of loose alluvial matter deposited in old "swallow holes" existed at the abutment sites. In chalky country "swallow holes" are formed by the solution of calcium carbonate by the waters of a river charged with carbon di-oxide. As the soft patches extended approximately vertically downwards, it was decided to drive 14 in. by 14 in. precast reinforced concrete piles 35 ft. long inclined so as to take the thrust of the abutment. The heads of the piles are incorporated in a reinforced concrete mat on which the mass concrete abutment bears. The bridge consists of a single reinforced concrete arch of 80 ft. span carrying a roadway 100 ft. wide. It is faced with bricks and provided with ornamental piers at each end. A section of the arch showing the reinforcements and a plan showing the position of the swallow holes are given. Several soft patches were also encountered on the line of the new road adjacent to the bridge. An original method of overcoming the foundation difficulty at these patches was evolved by the engineer in charge and is described. The method is based on the idea of covering the soft patches with a concrete dome the periphery of which would rest on solid chalk. Each dome consists of an annular reinforced ring taking the thrust from eight radial ribs between which spans a continuous diaphragm of concrete. A space was excavated round the soft patch for the annular ring. Filling was then placed on the patch and tamped to the profile of the interior of the dome. This was covered with waterproof paper and a one foot thick diaphragm of concrete was laid. The radial ribs were then cast on the diaphragm. Inspection chambers with an access shaft through the domes are provided for periodical inspection of the foundations. Concrete proportions in the bridge arch are 1 : 1½ : 3, and in the abutments and domes 1 : 2 : 4, standard slow setting Portland Cement being used.

VIERENDEEL GIRDER OR TRIANGULATED FRAME. Vierendeel.

Prof. Vierendeel of the University of Louvain, the originator of Vierendeel girders, describes the essential features of this type of girder and outlines the principles of design. The Vierendeel girder was introduced over 40 years ago and essentially consists of two booms united by verticals which frame into them by rigid joints at top and bottom. The top and bottom booms may either be parallel or the top boom may be curved for a portion or the whole of its entire length. At the present time, the type with the top boom having the shape of a parabola is preferred, being more economic and attractive in appearance. The verticals are connected to the top and bottom booms by means of gussets which are specially designed. The fundamental formulæ on which the design of Vierendeel girders is based are given, and the lines on which the design is to be worked out are indicated. Vierendeel girders have been the subject of numerous experiments with actual works and models with a view to checking the validity of the calculations and the efficacy of constructional design. Some of the experiments are briefly mentioned and all of the experiments confirm the accuracy of the formulæ. The stresses as actually measured are invariably 5 to 6 per cent. below calculated values.

The triangulated truss with diagonals is irrational according to Prof. Vierendeel, and should be abandoned in favour of the rational Vierendeel girder. Prof. Rabut, the great French exponent of acoustic measurements of stress has always found in his numerous experiments that the diagonals do little or no work, or sometimes operate in the opposite sense to that intended. He has expressed the opinion that triangulations are an absurdity and their design unworthy of engineering. During the last 40 years about 100 bridges of the Vierendeel type, of spans varying from 30 to 100 metres have been built to carry roads and railways in Belgium and the Belgian Congo. Rivetted Vierendeel girders work out 20 to 30 per cent. cheaper than rivetted triangulated frames, and welded Vierendeel girders 20 per cent. cheaper still.

This type of construction can also be adopted to arch bridges and suspension bridges which thereby acquire the same rigidity as simply suppported bridges without the use of stiffening girders.

PUMPING PLANTS OPERATED BY WATER POWER. McConnel.

Whenever small streams are found flowing down steep gradients or descending over rapids or waterfalls, the power available can often be employed economically for pumping purposes. Suitable pumping plants may be divided into three classes :—

1. Hydraulic Rams
2. Hydrostats
3. Pumps of the centrifugal or reciprocating type driven by reaction or impulse water turbines either directly or by means of gearing.

For small supplies the hydraulic ram is cheap in initial cost and maintenance. Commercial hydraulic rams are available which are capable of operating on falls of from 3 ft. to 80 ft. and of lifting water to a height of 800 ft. The successful operation of a hydraulic ram depends upon the length and diameter of the driving pipe and on this matter the advice of the makers should be accepted. For average conditions where the lift is not very great in relation to the fall the length of the drive pipe should be about six times the working fall. The length of the drive pipe may be longer where the fall does not exceed 6 ft. Efficiencies of 80 to 90 per cent. have been found in practice, and for working falls of over 10 ft., efficiencies of the order of 65 per cent. to 75 per cent. have been obtained over a wide range of conditions. Where the hydraulic ram is required to pump a supply of water other than that used for driving purposes, a modified type is available which has a lower efficiency and is more expensive. Water pumped by a hydraulic ram must have a free overflow at the delivery main.

Hydrostats are hydraulic pumps which are more elaborate and costly than hydraulic rams, and have an efficiency of 65 to 70 per cent. over a wider range af conditions than in the case of hydraulic rams. This type is in extensive use specially for boosting piped supplies—a purpose for which the hydraulic ram is unsuitable. The limiting size of a hydraulic ram will lift about 1,000,000 gallons per day, and for quantities in excess of this pumps operated by turbines will prove more suitable. In cases when plenty of drive water is available, turbine operated pumps may be able to compete with hydraulic rams when much smaller quantities of water are required to be pumped. Each of the three types of pumping plant discussed has its own field of usefulness.

MECHANICAL AIDS TO LAND DRAINAGE. Beaumont.

In many parts of England specially in the counties of Yorkshire, Lancashire, Lincolnshire, Somersetshire and the Fen District the land is flat and low lying, and artificial channels have been dug to drain the land. In the Fens where the land is below sea level, windmill pumps were formerly used in large numbers, some of which are still in operation, to lift the water into drainage channels in order to carry it away to the sea. Drainage work was neglected till the creation of Catchment Boards in 1930. The Catchment Boards are collecting data for various drainage areas to develop improvement schemes. The dredging of drainage channels was carried out exclusively by hand labour for hundreds of years before the advent of mechanical dredging equipment. The earlier types of equipment consisted of two types, a special type of dredging crane carried on a floating vessel, and a land dragline which moved on the banks of the drains. Both have their advantages which are enumerated, and in order to obtain the combined use of both

types a special type which could work on land and be shifted on to a floating pontoon when necessary, was developed. This type of 'amphibious' dredger is described in detail.

BUILDING SCIENCE ABSTRACTS.

ESSENTIALS OF SOIL COMPACTION.

Highway Research Board, U. S. A. Proceedings of the 16th annual meeting, by Hogentogler. Reference is made to two tests described by Proctor, a compaction test in which samples of soil of different moisture contents are tamped in a small brass mould, and a stability test in which the compacted samples are penetrated by a load indicating needle. The tests reveal the two basic relations of compacted soil, *i.e.*, that for any given soil there is an optimum moisture content at which maximum density can be obtained, and that stability drops off rapidly as the moisture contents fall below the optimum. Before compressed soil samples become completely filled with water they undergo four distinct stages of wetting—hydration, lubrication, swelling and saturation. These specific phases of soil behaviour constitute a useful tool in the selection of soils when compaction is a factor. The chemical composition of soil particles, the kind of ions present and admixtures having electro-chemical properties, influence the thickness of adhesive films and therefore affect the densities to which soil may be compacted. Curves illustrating these phenomena are given.

VACUUM CONCRETE.

Betong 1937(2) 170-5.—A description is given of methods of de-aerating concrete. Results of compressive strength tests of concrete of different mix proportions and ages, after subjection to the treatment showed an increase of from 22 to 107 per cent.

A NEW METHOD OF MEASURING THE WORKABILITY OF CONCRETE.

Ann. Inst. Tech. Bat. 1937, 2(1).—In this study of the workability of concrete a distinction is made between plasticity and fluidity. It is shown that although two concretes may have apparently similar fluidities, considerable variations may be noticed as regards their capacity of filling more or less completely, all free spaces in shuttering containing reinforcing rods. This is attributed chiefly to the sand gravel ratio. Tests of workability carried out are described in detail and a wide range of mixes was used in which the sand gravel ratio and water cement ratio were varied. The results are presented graphically and indicate the influence of the sand gravel ratio and water cement ratio on the capacity of the concrete to fill all spaces inside a shuttering containing reinforcements.

VOL. XXXIII.

No. 379—January 1938.

NOTES OF THE MONTH.

PROGRESS ON HAWESWATER DAM.

This dam is being built by the Manchester Corporation for the water supply of Manchester. The main body of the dam consists of 44 buttresses. The dam is 1,550 ft. long and 120 ft. high. The permanent outlets from the lake through the dam consist of two cast iron pipes of 36 inches diameter discharging into a stilling pool at the downstream face of the dam. About two fifths of the total amount of concrete in the dam has been placed so far. (See also under " The Engineer " 7th January 1938 in this bulletin).

EXPERIMENTAL WORK ON ROADS.

The report of the Experimental Work on Highways Committee for 1936-37 has been published. The results obtained from the numerous test sections of road laid down throughout the country with particular reference to wearing qualities and skid resistance are reviewed. The information obtained has demonstrated that concrete is suitable as a wearing surface for long periods without the super-imposition of other surfacing materials. Of eleven lengths of tar and bituminous roads, all but two have proved satisfactory, and have retained their skid proof qualities.

A NEW BUILDING MATERIAL.

A new compound material called *paxalumin* for roofing purposes is described. Up to the present aluminium, though possessing the advantages of great resistance to atmospheric deterioration, has not met with common use on account of cost. When aluminium is exposed to the atmosphere it becomes covered with an extremely thin coat of oxide which is a permanent protection against further atmospheric action. The durability of aluminium sheeting for roofing purposes depends on the oxide coating and not on the thickness of the plate. Thickness is only needed to give the sheet extra weight. In *paxalumin* this extra thickness is supplied by an impermeable coat of bitumen on a bituminous material. The sheet of this material is placed on the surface to be covered in the same way as sheet zinc.

MODERN TUNNELS AND OTHER STRUCTURES. Halcrow.

This is the presidential address delivered before the *Societe des Ingenieurs Civils de France* for 1937-38. The progress in the various branches of civil engineering are briefly reviewed, and reference is made to such organization as the International Association of Navigation Congresses and the World Power Conference and International Commission on Large Dams. The important matters dealt with by these organizations are briefly reviewed. The study of special cements for mass concrete structures has been undertaken by a research committee of the Institution of Civil Engineers. Some large works constructed during recent years including the Boulder Dam, the Laggan Dam, the Mareges Dam, the Assuan Dam and the Gebel Aulia Dam are mentioned. Tunnels for railways, roads, and conveyance of water built in various countries are then referred to and important features connected with some of them are described in brief. The longest railway tunnel is the Simplon tunnel 13 miles long. The largest road tunnel is the Mersey tunnel which has an internal diameter of 44 ft. and length of 10,584 ft. and carries four lines of traffic. Amongst tunnels for the conveyance of water the Shandaken tunnel of the New York water supply 18·1 miles long is claimed to be the longest in the world. The longest tunnel in Great Britain is the Ben Nevis tunnel, 15 miles long forming part of the Lochaber Water Power Scheme. The most remarkable tunnel is the one which carries a canal between Etang de Berre and Marseilles harbour. It is 4½ miles long, 72 ft. wide and 50 ft. high and was cut through rock, taking 15 years for its completion.

IRRIGATION IN AUSTRALIA. Antill.

This is a review of Australian Irrigation at the present day with reference to the topographical features of the country, the sources of irrigation water and the means of conserving water for irrigation. Over 36 per cent. of the continent has an annual rainfall of less than 10 inches. There is a vast arid region in the heart of Australia in which little can be done in the way of reclamation, though the soil is rich in plant foods, because water supply to this region is not possible at present. But around the borders of this arid tract specially near the large rivers very large areas have been rescued from sterility.

Australia's water is divided into artesian and surface supplies. There are several artesian basins throughout the continent, the two most important being the Murray Basin, and the Great Artesian Basin, the latter covering 570,000 sq. miles. In the artesian basins bores are provided at salient points. The bores are either flowing or sub-artesian, the latter term being applied to those bores in which the water does not flow to the surface of the ground but is pumped up. The number of bores in the different States of Australia is given and the quality of water available is also given in a few cases. The deepest bore is 5,000 ft. Boring is carried out by diamond drills, each foot down to 2,000 ft. costing between 14*s*. and 42*s*. The artesian supplies are valuable for livestock. As regards the value for agriculture it has been stated that the ground becomes rapidly saturated with sodium carbonate of which the artesian water contains about 30 to 35 grains per gallon. Fruits, lucerne, etc., have been successfully grown with this water but there can be little doubt that conservation of surface water will yield much better results. The cause of arid conditions in Central Australia and the formation of the artesian basins are discussed with reference to the geological history of the area.

The principal water conservation works in Australia are then mentioned and brief details are given. The major schemes are situated in the Murray River Catchment in Victoria and New South Wales. These include the Burrinjuck Dam on the Murrumbidgee River which is a tributary of the Murray River. This is a curved gravity dam of mass concrete and creates a reservoir of 771,641 acre ft. capacity, from which water is released into the river and is diverted at a weir 220 miles downstream into a 45 mile canal, leading to the irrigation area. The water released at the dam is also used for hydroelectric generation. The Goulburn weir on the Goulburn River in Victoria is a concrete structure 925 ft. long and raises the summer level of the river by 45 ft. This scheme supplies water to 1,300,000 acres of land. The weir is provided with 21 flood gates each 20 ft. by 20 ft. operated by screw gears driven by turbines, which obtain their power from the river water. Higher up the Goulburn River, a dam has been constructed to a height of 140 ft. above the river bed with foundations over 75 ft. deep in places. It is 3000 ft. long, 700 ft. being a mass concrete spillway and the remainder a rockfill embankment with concrete core wall. The dam impounds 306,000 acre ft. of water which is used for hydroelectric supply and for irrigation. The greatest of all water conservation projects in Australia is the Hume Dam, 5800 ft. long impounding 1,250,000 acre ft. The reservoir created covers an area of 33,000 acres. The main portion of the dam consists of an earth embankment with concrete core wallfaced on the upstream side with concrete slabs, flanked at one end by a concrete spillway. The earth embankment is 4300 ft. long, 142 ft. high, and 718 ft. wide at the base. The concrete spillway is 720 ft. long and is topped by 29 sluice gates each 22 ft. wide and 15 ft. 8 inches deep. The valve section forming the outlet works adjoins the spillway and is also of concrete. There are seven 7 ft. 6 in. diameter needle discharge valves. At the foot of the spillway is an energy dissipator consisting of a 25 ft. concrete wall. The Hume Dam is the principal feature of the Murray River Scheme which comprises a number of subsidiary works such as weirs and locks on the Murray River and some of its tributaries. Another interesting work is the Western Australian Gold fields water supply in which water impounded in a reservoir created by a 100 ft. high concrete dam is lifted to a height of 1300 ft. and carried 309 miles to a point whence it runs by gravity to the gold fields.

No. 380—February 1938.

ENGINEERING MODELS.

The editor refers to a paper entitled " An Experimental Investigation of the Effect of Bridge Piers and other obstructions on the Tidal

Levels in an Estuary" by Prof. Gibson read before the Institution of Civil Engineers, and draws attention to the increasing use of models in the investigation of problems concerned with the effects which results from the construction of various works. A considerable amount of research work has been carried out on a model of the River Severn in connection with the projected River Severn Barrage. In order to check the accuracy of the model in reproducing the tidal phenomena in the open estuary, observations of the levels of high water and the tidal range at spring tides were made on the model and the estuary, and the results show very close agreement.

NOTES OF THE MONTH.

LONG SPAN PIPE BRIDGE.

Two pipe spans have recently been completed in America having the record length of 105 ft. between supports. The structure carries sewage across the North Platte River to the sewage disposal works at Denver, Colorado. The pipe is 78 inches in diameter. Stiffener rings are welded to the pipe and the load is transmitted from these rings to the foundations by means of legs attached to the stiffeners.

THE BRISBANE RIVER BRIDGE. Bradfield.

The main features and details of construction of a steel cantilever bridge having a main span of 924 ft. and two side spans of 269 ft. across the Brisbane River in Brisbane, are described in this article.

GRASS PLANTING AS A MEANS OF TIDAL LAND RECLAMATION. Le Sueur.

(See under "Royal Engineers Journal" in this Bulletin).

THE CARRON DAM.

This dam is being constructed in connection with a water supply scheme by the Stirlingshire and Falkirk Water Board. The main dam is 1500 ft. long and has a maximum height of 42 ft. It consists of a central spillway masonry section 400 ft. long flanked by two earthen embankments with clay puddle core wall. The masonry portion is being built of rubble masonry in cement mortar faced where exposed with precast cement blocks. The overflow portion consists of 13 archways each 12 ft. 6 in. wide. Near the centre of this masonry section are two outlet pipes of 36 inches and 48 inches diameter for supply purposes. The earthen sections have inner slopes of 3 to 1 and outer slopes of 2½ to 1. The inside slope will be protected with stone pitching. The dam will create a reservoir with a capacity of 4,400 million gallons and the water surface area will be 900 acres.

THE HYDRAULICS OF LARGE RIVERS. Chatley.

In this article the author discusses the hydraulic problems in connection with three of the largest rivers in the world; the Yangtse, the Yellow River and the Mississippi. The author was connected with observations, projects and a few actual operations on the Yangtse and has also studied some of the problems of the Yellow River. He also collected available data for the Mississippi for comparison with those of the other two rivers. In this paper the author presents his views and conclusions regarding some of the hydraulic problems of large rivers in the light of the data collected.

The characteristics of the three rivers are briefly described. The rivers are all controlled in their alluvial reaches by levees. The provision of a wide flood channel has been considered in the cases of all the three rivers and in the case of the Yellow River has been tried for centuries and found to be unsuccessful. In the Mississippi, progressive rise of flood levels has led to the drastic course of cutting through the necks of a whole series of meanders. The author considers that the effect of these cut-offs in reducing flood levels is only local and the final results are uncertain. Reservoirs are rarely economic for flood control. One of the most important problems in connection with the control of large rivers is the frequency of floods. Difficulties in connection with estimating the highest water level that is likely to occur and the building of dykes higher than this level are discussed. Formulae relating the flood discharge with catchment area have been developed from Indian and American experience but can only be regarded as rough guides since results are different in different watersheds and in a limited number of years one particularly bad cloud formation may occur. The effects of removal of the forest cover in the watershed on run-off, increased deposition of eroded material in the delta or flood plain, increase in flood levels, and decrease in average rainfall on the watershed are briefly discussed. An idea of the enormous quantities of silt carried to the sea by large rivers can be had from the figures given for the Yangtse discharging 400,000,000 cu. m. of silt per annum, the Yellow River discharging perhaps 1,000,000,000 cu. m. and the Mississippi about 500,000,000 cu. m. In addition to these enormous quantities, comparable quantities are deposited in lakes and backwater areas. These materials are largely deposited at the mouths of the rivers and the shore line advances about 1 mile in 50 years on the Yangtse and perhaps 1 mile in 25 years in the Yellow River. The materials that are deposited in the bed of the sea reduce the depths of the sea near the mouths of the rivers.

The author then proceeds to discuss the flow formulae of Chezy and Blasins in their application to problems of river flow. A factor which affects the flow of large rivers is the effect of acceleration due to the earth's rotation on a mass of flowing water. Whenever a stream of fluid is moving over the earth's surface it is subject to a right handed (in northern latitude) acceleration due to the earth's rotation which requires a reacting force perpendicular to the flow. This reacting force has been expressed in mathematical terms and its value has been worked out for a hypothetical stream. The effect of this force is to stabilize pools on the right bank, that is, left hand turns, and causes greater erosion of the banks and greater depths in such turns than in those on the left bank. For the lower Mississippi the erosion is 9 per cent. greater on the right bank than on the left. In the Rhine the mean depth of the right bank pools is 4 per cent. more than those on the left bank. This effect was first noticed by Von Baer in the north and south running rivers in Russia and analysis shows that this effect applies to all directions except on the equator, and is the cause of important air and sea drifts. In conclusion the author discusses the profile of rivers and the causes which are responsible for the particular shape of the longitudinal profile of the river bed which forms a curve concave to the sky with a slope that decreases towards the sea. Lacey considers slope to vary directly as the cube of the particle diameter and inversely as the square root of the hydraulic radius. The decreasing slope in the river bed corresponds to increasing fineness of the alluvial material and increasing Reynold's number. Du. Boy's traction theory has been used to a great extent in the modern Mississippi investigations. This theory is briefly explained, and it is shown how the volume of the material scoured from the bed of a stream can be determined. It is deduced that since greater mean depth increases the tractive force on the bed, the equilibrium hydraulic slope diminishes with increasing depth. This explains the manner in which the slope of a river diminishes towards the mouth. A table showing lengths, slopes, discharges, water levels, and other hydraulic data of the three rivers is appended.

BUILDING SCIENCE ABSTRACTS. J. Bolomey :

Waterproofing of concrete and masonry structures. *Cimevt Armi* 1937, 19 (213). Methods of rendering concrete impermeable to water are discussed.

CONCRETE AND CONSTRUCTIONAL ENGINEERING.

VOL. XXXII.

No. 12—December 1937.

EDITORIAL NOTE.

The Editor draws the attention of readers to a pamphlet " Memorandum on the Lay-out and Construction of Roads " issued by the Ministry of Transport which contains some important recommendations on the design and construction of rod bridges based on experience in England during the past six years. The object of the recommendations is to secure greater uniformity of practice based on principles that experience has proved to to be sound.

BENDING MOMENTS IN COLUMNS.

Gray.
Griffith.

In this article the authors have tried to show that the formulae recommended in the Code of Practice for Reinforced Concrete for the bending moments in the external columns of frames of one or more bays give only approximate results and seriously underestimate the moments in these frames. A practical case is worked out by the method recommended in the Code and by the standard slope deflexion method, and the results are compared. The results show that the error in the case of the method recommended by the Code is in some cases in excess of 25 per cent.

RAPID DESIGN OF TEE-BEAMS.

Ashurst.

The author presents a number of graphs by the use of which tee-beams with free ends carrying uniformly distributed loads can be designed with accuracy and speed. He explains the method of using the graphs and solves two examples to illustrate it. The system is based on a mix of 1 : 2 : 4 concrete with $t = 18{,}000$, $c = 750$ and $m = 15$.

DESIGN OF PILED FOUNDATIONS.

This is a translation from " De Ingenner " of an article by C. Fraux. According to the author the reactions in piles are based on the consideration that due to the load the pile head undergoes three movements, namely, (1) vertical displacement, (2) horizontal displacement, and (3) rotation. He considers a pile system subject to horizontal, vertical and rotating forces due to a load and derives equations for pile reactions and displacements. These equations show that displacements and pile reactions are linear functions of the horizontal, vertical and rotational forces due to the load. He proceeds to show that calculation of displacements is more important than calculation of pile reactions because it is very likely that tolerable pile reactions may be accompanied by intolerable displacements. An idea of the factor of safety is readily obtained if displacements are calculated as functions of the loads. He then discusses a few examples of a transverse beam on three piles under different conditions for which the displacements and pile reactions are worked out. The expressions for displacements and reactions are then studied analytically and their physical interpretation with regard to behaviour of foundations in each case is given. This comparative study of different arrangement of piles supporting a transverse beam also shows how the behaviour of the pile foundations can be predicted from the displacements and reactions worked out theoretically.

FLOW IN CHANNELS.

Hogan.
Gibbs.

This article is continued from the previous issue. Frictional resistance in open channels is dealt with. The Chezy equation is generally used to calculate discharge of channels and the value of the co-efficient in this formula has been determined by a formula based on experimental results. The three formulae commonly used to obtain the value of the coefficient C in Chezy's formula $v = c\sqrt{mi}$ are those of Ganguillet and Kutter (also known as Kutter's formula), Manning and Bazin. The Kutter formula has been more widely used in Britain and the United States than any other. A discussion of the Kutter formula is given showing how it was derived. Ganguillet and Kutter gave a diagram to facilitate the use of the formula, which is reproduced. The measurements by Humphreys and Abbot on the Mississippi on which the slope term in the Kutter formula was based were made in the period 1851-56. The slope was about one fifth of an inch per mile and it is doubtful whether the levelling was sufficiently accurate to justify the assumption that such flat slopes could be measured. There is some doubt about the velocities also as these were measured with sub-surface floats. The measurements were repeated by the Mississippi River Commission in 1912 and it was found that with discharges of the same order as those observed by Humphreys and Abbot, the slopes were ten times greater than those in the previous measurements. In view of this very definite proof of the unreliability of the slope measurements on which the Kutter formula is based, the continued use of this formula cannot be defended. The errors in the slope measurements were suspected by Manning who in 1890 proposed another formula. The World Power Conference in 1933 recommended the use of Manning's formula in connection with open channels. In 1897 Bazin reviewed the data accumulated since 1860 and derived another formula. Values of coefficients in the formulae of Kutter, Manning and Bazin for various types of channels are tabulated. The authors mention that up to the present time no really satisfactory general theory has been developed which will enable the resistance of a given channel to be calculated from a knowledge of its size and kind of surface. Formulae forty years old are used in nearly all modern design work, and these are based on results obtained seventy or eighty years ago.

The conveying capacity of a channel section is next dealt with. The actual shape of a channel section depends on the material of which it is constructed, and varies from vertical side slopes in the case of rock to side slopes of 2 to 1 and more in the case of unstable material. The side slope must be less than the angle of repose. An expression is derived for the discharge of a channel section per unit time for a slope of unity and this is a function of the depth. Uniform flow is next discussed. In uniform flow the cross sectional area and the depth of the stream must remain constant so that depth energy and kinetic energy will be constant. The losses due to the frictional resistance balance the effect of the bed slope. Expression for discharge in the case of uniform flow is derived.

WELDING IN REINFORCED CONCRETE CONSTRUCTION.

This is an abstract of a paper by Mr. J. Cuerel read before the Reinforced Concrete Association describing the experiments made to determine to what extent welding might advantageously be adopted in the design of the new Waterloo Bridge. The objects of the experiments were :—

(*a*) to verify the reliability of butt welded joints in round m. s. bars,

(*b*) to determine a safe working stress for such welds,

(*c*) to investigate the most suitable type of electrode, preparation of bar ends, and procedure,

(*d*) to obtain information about the precautions required to ensure good results,

(*e*) to investigate the possibilities of welding intersecting bars and the strength of spot welds.

The tests showed that a weld made by a welder of average ability with suitable preparation, electrodes, equipment, and procedure will develop the yield strength of the bar. A butt weld was considered to be able to develop the ultimate strength of the bar, fracture occurring well away from the joint. The chances of a weld failing at or near the working stress are too remote for practical consideration. The types of butt joints evolved as a result of extensive tests are then described and recommendations for arranging them in practice are given. Reinforcement details which can be simplified by welding are specified and examples are illustrated.

THE EMPIRE JOURNAL OF EXPERIMENTAL AGRICULTURE.

VOL. V.

No. 17—January 1937.

SOIL PROBLEMS OF THE ANGLO-EGYPTIAN SUDAN. Greene.

Some aspects of the importance of soil research and investigations in the Sudan on a large scale are discussed in this article.

THE ENGINEER.

Vol. CLXIV.

No. 4275—December 17, 1937.

Twist Effects in Straight Gravity Dams. Houk.

During the last few years effects of twist action have been analysed in working out designs for several straight gravity dams of major size and importance. The first such analysis was made in studying alternative designs for the Boulder Dam. This was followed by analysis of twist conditions in a number of dam designs including the Madden, Morris, O'Shaughnessy, and Grand Coulee Dams. These analysis show that appreciable proportions of loads are transferred laterally by the twist action in the end sections of the structures to the abutments. The high central cantilevers of the dam tend to deflect downstream farther than the end cantilevers under the waterload due to their greater height and greater total load on the upstream face. The central cantilevers tend to pull the end ones downstream while the end ones resist this tendency, resulting in the twisting of vertical elements and the lateral transfer of a portion of the waterload to the abutment rock. The load on the end cantilevers is also increased and failure by sliding may take place in the case of large structures where the shear resistance is not great enough to prevent failure.

The important effects of twist action on stresses, sliding factors and shear friction factors in straight gravity dams are stated. The sliding factor, shear friction factor and cantilever stresses are defined and the method of determining them is indicated. The general theory of twist action is discussed in relation to the water load and dead load of the structures. The method of analysis of twist action in a straight gravity dam is then explained and the formulae used in calculating the deflections of the twisted structure are set forth. The deflections of the twisted structure are greatly reduced by the grouting of the construction joints.

Miscellanea.

A Concrete Reinforcing Bar Research.

The concrete reinforcing steel Institute of the United States in co-operation with the Lehigh University is to carry out a series of tests to ascertain the effects of rust on the bond between reinforcing bars and concrete. In the preliminary programme 5/8 inch round deformed bars taken directly from ware house stock and of varying degrees of rustiness will be set in concrete cylinders leaving one end exposed. The force required to produce initial slip in the bars will then be measured.

FLOOD RELIEF SCHEME FOR LEE VALLEY.

The Lee Catchment Board has prepared a scheme of flood relief in the Lee Valley, the essential features of which are the widening of the River Lee in a certain reach and the construction of a new diversion channel 3½ miles long across certain marshes. This flood channel will join the river lower down opposite the Banbury reservoir.

LETTERS TO THE EDITOR.

LONDON'S FLOOD RISK.

Mr. R. A. Ryves comments on an article by Major Newhouse entitled " Thames floods " (see page 37 of Bulletin No. 8). He considers that the relation of recorded intensity of rainfall to an area of 1100 sq. miles has been underrated in the article. He discusses some factors in the flood risk and gives some practical conclusions relating to the measures which may be adopted in dealing with this problem. These include collection of data pertaining to relation between winds and high tides, construction of reservoirs in the Thames Basin, and prohibition of any works in the basins which are likely to reduce the flood plains of any of the rivers flowing into the Tidal Thames.

No. 4276—December 24, 1937.

TWIST EFFECTS IN STRAIGHT GRAVITY DAMS. Houk.

This is in continuation of the article in the previous issue. Results of twist analysis made in connection with the design of the Grand Coulee Dam are presented. The results are shown graphically in a number of diagrams and important conclusions with regard to load distribution, deflection, shear friction factors and stability factors, compressive stresses arrived at from a study of the analytical results are discussed. A plaster celite model of the dam built for the purpose of studying twist action cracked at points which agreed almost exactly with those at which high tension stresses are indicated by the mathematical analysis described above. A table showing the effects of twist action in some gravity dams analysed under the author's direction, and giving the principal dimensions of the twisted structures, sliding factors, shear friction factors and cantilever stresses is given. The data presented show appreciable twist effect in all the dams analysed. Maximum sliding factors were increased in all cases. The effect of grouting construction joints is to intensify twist action because a greater proportion of reservoir loads are carried horizontally to the abutments thus increasing the effect of twist on sliding factors and cantilever stresses. Moreover, grouting cause extension of twist effects further into the central sections of the structures which are rendered monolithic. Theoretically twist effects may sometimes be kept within permissible limits by leaving the construction joints ungrouted or by grouting under partial reservoir load so that readjustment of deflections can take place at the joints before the structure is made monolithic. Practically, however, such procedure can seldom be recommended.

As far as the writer knows no provisions for relieving twist action have been made in the construction of straight gravity dams built so far. The maximum effects of twist action in gravity dams built in V shaped canyons may sometimes be beneficial rather than detrimental as in the case of O'Shaughnessy Dam. In the case of U shaped canyons with relatively steep side walls the effect is detrimental in view of the increased danger of sliding along the upper part of the abutment slopes together with undesirable development of horizontal tension stresses which cause cracking on the upstream face at the abutments.

Probably the best way to relieve twist action in which analysis shows such effects to be detrimental is to provide one or more open transverse slots in the abutment sections of the dam. Such slots constitute definite barriers to the horizontal extension of beam and twist action and permit readjustments of the unequal cantilever deflections on the two sides of the slots. The slots should be closed by some special type of construction at the upstream face capable of sliding adjustment at one or both seats during the application of the reservoir load.

In the construction of the Grand Coulee Dam where twist effects are important, the proposal to provide three open slots in each abutment section is being considered. The slots will probably be 5 ft. wide and will be placed at equal intervals.

These articles are based on the work done in the Denver office of the Bureau of Reclamation.

No. 4277—December 31, 1937.

SURGE TANKS. Watson.

The surge tank is an essential feature of a pipe line supplying a hydro-electric plant, and is located at the junction of the conduit conveying the water from the reservoir over a conparatively flat country and the penstock which conveys the water down a steep slope to the generating plant. It is intended to enable the water to surge up and down through a vertical distance of several feet. The object in making this provision is to regulate the pressure in the line so as to prevent its excessive rise or fall on sudden variations of load. Some types of surge tanks are described in this article and their function is explained. Formulae used in the design of surge tanks are given. Illustrations of some surge tanks in actual existence and line diagrams of others are also given.

MISCELLANEA.

HYDRO-ELECTRIC SCHEME FOR HYDERABAD.

The Chief Engineer of the Hyderabad Government has submitted a report on proposed new hydroelectric schemes which include the utilization of the waters of the Godavari and Krishna Rivers for developing 145,000 k. w. of power.

VOL. CLXV.

No. 4278—January 7, 1938.

THE LLOYD BARRAGE.

A brief note mentions that the completion report of the Lloyd Barrage Project has been published. Main features of the barrage are mentioned. The scheme will irrigate ultimately 5,250,000 acres annually, and is expected to yield a return of 3·73 per cent. by 1942-43 and 7·39 per cent. ten years later. The area under cultivation will be nearly trebled.

RIVER CONTROL AND WATER STORAGE IN 1937.

A survey of important river control and water storage works completed and in progress during the year is contained herein. River control works are now being undertaken in many parts of England and typical of these are the Dog-in-a-Doublet lock and sluices on the river Nene and the Allington sluices on the Medway. The Haweswater dam for the water supply of Manchester is under construction. It is 1550 ft. long and 120 ft. high and the reservoir created will have a storage capacity of 19,000 million gallons. The dam is of buttress design of an unusual type. Diagrams showing the plans and elevations of the dam are given. The Ladybower reservoir dam was also under construction during the year. This is an earthen dam with a concrete core wall 1250 ft. long and 143 ft. high. A project for the construction of a barrage across the Thames at Woolwich was under discussion. The Port of London Authority is however opposed to the scheme and a public enquiry into the scheme will open in March 1938.

Works abroad include the Shing Mun Dam in Hongkong which was completed, the Vaal-Hartz scheme in South Africa which is under construction, and a scheme for the water supply of Durban which is under consideration.

In America there are numerous hydroelectric, water supply, river control, and irrigation projects in hand. The works on the Columbia River including the Grand Coulee Dam are mentioned as a typical example.

In a pictorial supplement to the present issue some of the works mentioned above are shown.

No. 4279—January 14, 1938.

MISCELLANEA.

A booklet recently published by the Northern Aluminium Company, London, deals with the use of aluminuim paste paint for the protection of wood, metal, steelwork and cement finishes.

WATER SUPPLY AND SANITARY ENGINEERING IN 1937.

A review of important water supply and sanitary engineering works in Great Britain and France during the year 1937. The Eyebrook Reservoir in Corby and the Ladybower Reservoir in the Derwent valley were under construction. Both of these reservoirs are formed by earthen dams with concrete cut-off trenches. The aqueduct from Lake Vyrnwy was also under construction and includes a tunnel under the river Mersey. The tunnel will be 10 ft. in diameter 945 ft. long and 40 ft. below river bed and will be lined with cast iron segments covered over with concrete. The article is to be continued.

SOUTH AFRICAN ENGINEERING NOTES.

The Government of the Union of South Africa in view of the drought which is seriously affecting the Union, decided to release flood water from the partially completed Vaalbank Dam and the Vaal-Hartz weir of the Vaal-Hartz Irrigation Scheme which is at present under construction. The result is that where previously the river was drying up there is now a strong stream flowing for 440 miles below Vaalbank Dam. This has been achieved with an amount of storage considerably less than one tenth of the full storage of the dam when completed.

HARBOURS AND WATERWAYS IN 1937.

A brief review of works connected with harbours and inland waterways in Great Britain and other countries is given herein.

No. 4280—January 21, 1938.

HARBOURS AND WATERWAYS IN 1937.

Continued from previous issue. Important harbour works in Europe, Africa, America, and Asia are briefly described. The Soviet Government opened the Moscow Volga canal, and work is in progress on the Marinsky Canal system which will connect Moscow with Leningrad. Preparations are being made for constructing another canal connecting the lower Volga with the river Don which will connect Moscow with the Black Sea. In Germany the Elbe is being developed for navigation. The canalisation of the river Weser is being carried out and the work includes five dams with navigation locks. A number of other rivers including the

Danube, the Neckar and the Rhine have been canalised. In France, the Rhone improvement project designed to regulate the Rhone for navigation is in progress. Genessiat Dam, which is a part of this project is under construction. The construction of barrage reservoirs on the Seine continues to make progress. The reservoirs created will control floods on the Seine and will also regulate the flow of the river and produce electrical energy. Two of these have been completed, the third nearing completion and the fourth is about to be started. In America, floods of phenomenal magnitude swept down the valleys of the Ohio and Mississippi Rivers in January and February 1937. The Jadwin plan of flood control on the Mississippi which was sanctioned in 1931 and provided for levees of increased height on the lower Mississippi and a number of spillways, came in for the first crucial test. The levees stood the test. After the floods had subsided, the National Resources Committee recommended an immediate expenditure on further flood control works in the Ohio and Mississippi Valleys which include levees and reservoirs. An estimate prepared by the Chief of Engineers U. S. Army indicates that complete flood control in the Missisippi valley would require 150 flood reservoirs costing about £250 millions. A number of other works for improvement of navigation are in progress including the Bonneville Dam on the Columbia River which will enable deep sea going vessels to proceed 95 miles above Portland along the river.

WATER SUPPLY AND SANITARY ENGINEERING IN 1937.

Continued from previous issue. The Haweswater Dam for the water supply of Manchester is nearing completion. Water supply and sewage works at other cities are mentioned in brief. In West Cheshire a scheme of water supply to Wirral Peninsula was inaugurated in October 1937. In this scheme the water is pumped from boreholes by electrically driven pumps and is forced by boosters up to a service reservoir on a hill 2 miles away. The service reservoir is a 262 ft. diameter mass concrete structure with reinforced concrete floor and roof slabs. An aqueduct 12¾ miles long conveys the water from the service reservoir to existing pipe lines at the place of distribution. In France, work has been started upon the scheme for constructing a barrage across the Alpine River 7½ miles from Cannes. The water will be raised to an elevated reservoir at Cannes and will be distributed therefrom. In Burma, the construction of the Pegu Yomas reservoir consisting of an earthen embankment 136 ft. high is in progress. The reservoir will impound 2370 million cubic ft. of water and will augment the water supply of Rangoon. The tunnel for diversion of the river is nearing completion and the excavation for the core wall in the river bed has been started.

LETTERS TO THE EDITOR.

THAMES FLOODS.

The writer comments on the article of the above title by Major Newhouse published in the issue of the 10th December. He mentions one factor omitted by Major Newhouse which may aggravate flooding namely the great reduction in width of the Thames below Teddington. During the last 70 years a number of embankments and wharves have been constructed particularly within the London County Council area, which tend to an increased residue of tides in the river. Major Newhouse favours dredging as a means of making the country side absolutely safe. The writer does not agree with this view in the case of a tidal river and is of opinion that to whatever depth the channel is dredged, it cannot have any influence upon tide level. The Thames in the tidal reach also drains the subsoil water of the gravel strata which outcrops on the Thames bed, more particularly the subsoil water of the Lee valley. Dredging in Bow creek by which means the gravel was exposed has been known to render the land water tidal. It will be interesting to see how the sponsors of the Thames Barrage propose to deal with this underground drainage when, as they propose, the water level between Woolwich and Teddington is stabilised at a level some 14 ft. above it.

MISCELLANEA.

AN UNUSUAL CHIMNEY CRACK REPAIR.

Four years ago a crack appeared at the top of a 125 ft. high chimney stack of a power plant at Fort Oglethorpe in U. S. A. The crack eventually worked down for a distance of about 40 ft. and the width of the crack in the upper 25 ft. was about 3 inches. As the engineer of the plant was unable to get an appropriation to repair the crack, he planted three slips of Florida vine at the bases of the stack. Two of these grew and within a year encircled the crown of the chimney and actually began to pull the crack together and close it. Now after 4 years the vine is 3 inches thick and the crack is said to have entirely closed except for a short length at the top of the chimney.

No. 4281—January 28, 1938.

THE EBBW VALE WORKS RESERVOIR.

Some time ago, cracks were discovered in the concrete core wall of the dam forming the water supply reservoir at Ebbw Vale in Wales. This dam is of the gravity type 52 ft. high constructed of shale with a core wall of concrete 5 ft. thick carried down to impervious rock 35 ft. below the surface. Recent rains in the area necessitated safety measures and the engineers in charge took steps to lower the level of the water in the reservoir. The engineers who constructed the dam were however of the opinion that cause for alarm was entirely unnecessary. The subsoil was feeling the weight of the newly constructed dam and this was shown by some minor cracks in the concrete core wall.

LETTERS TO THE EDITOR.

THAMES FLOODS.

Major Newhouse the author of the original article entitled "Thames Floods" replies to the comments on that article by Mr. McKaig published in the previous issue. Contrary to the opinion held by the commentator that three exceptional phenomena namely low barometer, high wind, and intense local rain cannot coincide to produce a maximum flood, the author is of the view that they might coincide though chances are very small. He gives arguments in support of this view. He also holds that dredging of the river bed would modify the flood levels in the upper reaches of the Thames Estuary where high levels are due not directly to the tide but to the interaction of the tide.

No. 4282—February 4, 1938.

THE THAMES BARRAGE INQUIRY.

The Port of London Authority who have agreed to a public enquiry on the proposal to construct a barrage across the River Thames invited proposals for the construction of such a barrage. Five such proposals have been submitted three of which are briefly referred to herein.

THE GRAND COULEE DAM.

This is a comprehensive article on the Grand Coulee Dam which is being constructed across the Columbia River. Features of the Columbia River and its basin are described. The waterway of the river is second only to that of the Mississippi River among the rivers of the United States. The average discharge of the river at the dam site is 109,000 cusecs and the maximum recorded discharge is 492,000 cusecs. The river rises from 40 ft. to 62 ft. during high water. The river is virtually free from silt and the impurities that cause turbidity during flood stages are nearly all held in suspension and will continue downstream without being deposited in the pool above the dam. The Grand Coulee is a natural reservoir formed on the rocky plateau bordering the river. Owing to the formation of an ice sheet in that part of North America in the distant past, the flow of the river was impounded and the level was raised until the water escaped south-westward over the rocky floor of the plateau and eroded this floor to form the Grand Coulee which is 52 miles long, 2 to 5 miles wide and 900 ft. deep. The floor of the Grand Coulee is 600 ft. above the low water level of the Columbia River at the dam site. About half the length of the Grand Coulee is to be used as a stabilizing basin for water pumped into it at its northern end and then released at its southern end into an irrigating canal system. The basin will have a storage capacity of 1,050,000 acre ft. and the water can be distributed by gravity flow so as to irrigate 980,000 acres, and 220,000 acres at higher elevations will be irrigated by pumping. The water impounded at the dam will be pumped 367 ft. into a 1·7 mile long canal which will carry the flow to the northern end of the Grand Coulee reservoir.

The dam is to be 557 ft. high, 4,200 ft. long, 500 ft. wide at the base and 30 ft. wide at the top. It consists of a central spillway section 1,650 ft. long surmounted by eleven openings 135 ft. wide by 28 ft. high controlled by drum gates. The toe at the downstream base of the spillway will have the form of a deep trough which will break the force of descending water. The central spillway section is flanked by two abutment sections 1,220 ft. and 1,330 ft. long, respectively, and on the downstream side of these abutment sections the power plants will be constructed. Adjoining the west abutment on the upstream side of the dam will be built a reinforced concrete pumping plant for pumping the water into the canal which will take it to the Grand Coulee Reservoir. A number of diagrams and illustrations showing the layout, dimensions and views of the dam under construction are given. The article is to be continued.

ELECTRIC POWER IN INDIA.

This article gives a description of the Ganges Canal Hydroelectric Scheme in the United Provinces which has recently been completed. The scheme is described with brief details of the power stations and the transmission system. Reference is made to the State Tube Wells Scheme in which the power produced has been utilized to lift water from tube wells for irrigation purposes. Costs and return of the schemes are discussed.

A DAM AND BRIDGE LABORATORY.

A laboratory for the testing of dams and bridges has recently been established at the Office Nationale des Recherches et Inventions at Bellevue, near Paris. The dams to be tested are built to exact scale and in the material to be used for the finished dam. The scale is generally either 13·6 to 1 or 20 to 1. In the floor of the building has been built a valley in concrete at the side of which is the equipment whereby the dam to be tested is placed under mercury or water pressure and its reaction to the pressures is measured. The procedure of applying mercury pressure to the dam and the method of recording are described. A number of new instruments were designed for making the measurements and include a photo-electric extensometer and an apparatus for coloured light photo-elastic measurements. These are briefly described with the method of using them.

No. 4283—February 11, 1938.

THE GRAND COULEE DAM.

Some interesting details of construction of the Grand Coulee Dam are given in this article. Mechanical equipment was used for mixing and laying concrete. A suspension bridge 150 ft. high and 3,400 ft. long specially built by the contractor carries a belt conveyor which transports concrete aggregates from the east side of the river to the mixing plant on the west side, and over the same bridge is led an 11 inch pipe line through which dry cement is blown from the silos. A belt conveyor system was also installed to remove the spoils from the excavation to Rattlesnake Canyon a mile away where it was to be deposited. These conveyor systems are described in detail. The construction of the cofferdams was the first step in the diversion of the river. Details of the cofferdams are given. The article is to be continued.

SCIENTIFIC AND INDUSTRIAL RESEARCH.

The report for the year 1936-37 of the Department of Scientific and Industrial Research has been published. The work done in the various sections is briefly reviewed herein. Building research included researches on pile driving, vibrated concrete, soil mechanics and reinforced concrete. Work has been done to develop a simple peak stress indicator for piles. Tests have been carried out on vibratory methods of placing concrete using a specially designed vibrating machine. A coring too has been developed with which undisturbed soil cores can be obtained from a greater depth than was hitherto possible. Several failures of embankments and cuttings have been inspected and soil samples have been obtained to collect data on the stability of earth slopes. Reinforced concrete research includes a study of the effect of pretensioning concrete as a preventive of cracking.

WEIR AT NIAGARA.

A concrete weir has been constructed across the Niagara River about one third of a mile above the Horseshoe Fall. Its purpose is to restore the level of the water at this point to that which existed in 1905 when the hydroelectric power station at the site was built. The levels had become abnormally low of late owing to low water levels in the Great Lakes and the diversion of water by later power plants upstream. Construction started with the building of a long pier extending out into the river for supporting the tracks for the construction crane and other equipment. The pier consisted of 51 separate steel frame structures each of which supported a timber bin. The frames were dowelled to the rock of the river bed and the bins were filled with gravel. Behind this pier, cofferdams of sheet steel piling were erected. The enclosed cells were pumped dry and the river bed was cleaned to solid rock, the rock drilled for steel dowels, and the concrete poured in the dry.

No. 4284—February 18, 1938.

THE GRAND COULEE DAM.

Further details of construction procedure at the Grand Coulee Dam are given. The freezing of an ice arch to stop sliding of the overburden in the east cofferdam area is described at length (see page 96 of Bulletin No. 5). Brief details of the concrete mixing plants are given and arrangements made for the cooling of concrete are described. The foundation rock beneath the upstream base of the dam was grouted under low pressure for a width of 60 ft. and a depth of 20 ft. before the concrete was placed. After placing the concrete a high pressure grout curtain was provided by forcing grout into drill holes 100 ft. deep. Drain holes arranged in a single row parallel with and downstream of the grout curtain have been drilled to a depth of 50 ft. and are spaced on 10 ft. centres. Drainage water will be carried by gravity to the downstream face of the dam where possible and by pumping from drainage sumps elsewhere.

No. 4285—February 25, 1938.

MISCELLANEA.

THE THAMES BARRAGE SCHEME.

Sir William Prescott, Chairman of the Metropolitan Water Board speaking at a dinner drew attention to the effect of the proposed barrage on London's water supply. The effect should be considered of a quiescent lake 30 miles long with a drought such as was experienced a few years ago, when no water would pass over the dam and all the sewage from many towns would enter the Thames, as well as storm water which was more foul than sewage emptyings. At a recent meeting of the Metropolitan Water Board it was decided to oppose the scheme.

THE DEVELOPMENT OF SINGLE-BUCKET EXCAVATORS. Savage.

A new type of excavator is described with special reference to means of mounting and locomotion.

No. 4286—March 4, 1938.

A NEW CEMENT.

A new hydraulic gypsum cement characterized by extraordinary strength and far superior to anything hitherto available in the field of gypsum cements has recently been announced. While ordinary Portland cement has little tensile strength this new cement is said to sustain 600 lbs. to 1200 lbs. per sq. inch in tension and to have ten times this strength in compression. It is claimed to resist weather with less expansion and contraction than Portland cement and has improved resistance to corrosion. It can be made at the same cost as Portland cement.

THE DEVELOPMENT OF SINGLE-BUCKET EXCAVATORS. Savage.

This article is continued from the previous issue. General construction and details of a new type of excavator are described herein.

No. 4287—March 11, 1938.

A GRAPHICAL METHOD OF ANALYSIS FOR TORSIONAL VIBRATIONS. Dick.

A graphical method is described for the analysis of torsional vibrations in a structure.

SOUTH AFRICAN ENGINEERING NOTES.

The Department of Irrigation will start investigations into the possibilities of finding a suitable site on the Orange River for a large storage dam to regulate the flow of the river. Silting of reservoirs is one of the most important problems which the Department will bear in mind in selecting the site. In the past many reservoirs with magnificent storage to start with were speedily silted up and became a dead loss.

BRITISH PATENT SPECIFICATIONS.

A machine has been patented for washing sand and gravel free from mud and delivering it as free as possible from the entrained moisture. This is briefly described.

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No. 3625—July 5, 1935.

THE CONVEYANCE OF SOLID PARTICLES BY FLUID SUSPENSION. Davis.

In this article the author attempts to establish a general principle embracing the conveyance of solid particles in both liquids and gases. The velocity at which particles commence to be taken up in suspension by a clear fluid passing horizontally over them is investigated and an expression for this velocity is obtained. The application of this equation to the case of erosion in river beds is discussed, and comparison is made with other empirical formulæ for velocity at which erosion commences in river beds. The practical application of the equation obtained is illustrated by an example. The saturation velocity of a horizontally flowing liquid conveying non-floating particles in suspension is next discussed and an equation is derived for this velocity. An example is given of the application of this equation in practice.

GROUND WATER SUPPLIES. Lacey.

The importance of conserving ground water supplies in England is explained. Geological conditions affecting the occurrence and transmission of water through underground strata are discussed. The question of the conservation and the artificial increase of the yield of subterranean water bearing areas is considered. Improvements in agriculture leading to the extensive adoption of land drainage of farm lands has the effect of passing off the rainfall more rapidly than before into streams reducing percolation. Speculative building on reparian lands has led to a demand for increased capacities of river channels to pass off floods more quickly. Indian rivers flow in great beds of sand extending to considerable depths and the main channel moves alternately from one alluvial margin to another in a tortuous course. In the rivers of England this unceasing change is not a marked feature. In high floods the river overflows its banks and submerges a certain extent of the adjacent lands, and as the flood slowly subsides, the water has time to percolate into the soil. To widen such a river so as to carry away the floods as quickly as possible would be to deprive the ground water of its supplies. An obvious remedy for such conditions is to prohibit building on riparian lands. Another method is to return the flow of built up areas, roadside drains, and field drainage back to ground water through absorbing wells or soakage wells. General features of absorbing and soakage wells are described. They may either be formed in the same manner as ordinary wells or by deep borings. An example is quoted of a 400 ft. steel lined boring put down to pass surplus water into the subsoil.

VOL. CXLIII.

No. 3716—April 2, 1937.

INTAKE TOWERS AND 32-FT. CYLINDER GATES AT BOULDER DAM. Kinzie.

Intake towers for the water supply to the power plants at Boulder Dam are described. Each tower is provided with two axially aligned cylinder gates 32 ft. in diameter by 9 ft. 5¼ inches high. The lower gates are in the bases of the towers and the upper gates are 150 ft. higher. The towers are of reinforced concrete designed to resist full external water pressure. Details of the towers are given with a number of plans and diagrams.

THE ABSORPTION OF WATER BY SAND.

This article deals with the absorption of water by fine aggregate for concrete mixtures. A report dealing with this subject appeared in the August 1936 issue of *Public Roads* published by the Bureau of Public Roads, U. S. A. in which Dr. Woolf discusses two recognized tests to determine the percentage of water absorbed by the sand. In one, a ratio is obtained of the weight in air of a given volume of permeable material to the weight of an equal volume of distilled water at the same temperature. In the second, a 500 gramme sample taken from a saturated and surface dried sand is placed in a glass jar. Water is added to the sample drop by drop with thorough shaking until the sand grains just tend to adhere to the sides of the jar. The weight of the sample is then found, and the sample dried to constant weight. Dr. Woolf advocates a new method in which a 1,000 gramme sample of sand is immersed in water for three hours and on removal is subjected to frequent stirring and exposed to a gentle current of warm air. When it approaches a surface dry condition trial determinations with a cone are commenced. A truncated sheet metal cone 2⅞ inches high and top and bottom diameters 1½ inches and 3½ inches respectively is filled with the sand and lightly tamped 25 times with a 12 oz. metal rod having a flat face 1 inch in diameter. The cone is then lifted vertically and if the sand does not slump surface moisture is present and the drying process is continued until the sand slumps on removal of the core. The percentage of absorption can be determined by weighing the sand before and after drying.

No. 3717—April 9, 1937.

INTAKE TOWERS AND 32-FT. CYLINDER GATES AT BOULDER DAM.

Kinzie.

This article is continued from the previous issue and describes details of the intake towers and cylindrical gates for Boulder Dam.

No. 3727—June 18, 1937.

THE DETERIORATION OF STRUCTURES IN SEA WATER.

This is a review of the sixteenth interim report of the Special Committee appointed by the Institution of Civil Engineers to investigate the deterioration of timber, metal, and concrete in sea water. The report gives a detailed account of the investigations carried out and results obtained.

No. 3728—June 25, 1937.

THE HUNTINGTON PUMPING STATION OF THE SOUTH STAFFORDSHIRE WATERWORKS COMPANY.

This article is continued from a previous issue and describes the booster pumps and water treatment plants. Results of official trials of the pumping plant are also given.

Vol. CXLIV.

No. 3735—August 13, 1937.

The Chambon Reservoir, Isere, France. Rich.

A detailed description of the Chambon Reservoir project is given herein. The main object of the project is the regulation of the flow of the Romanche River and to increase flow in the dry season. Previously, the extreme fluctuations of the flow of the river proved a great handicap to the large and important factories situated in the valley of the river. The increased supplies available would increase the output of the group of generating stations concerned by about 12 million K. W. H. In addition to the increased output, the regulation will benefit riparian owners and the towns on the river by eliminating floods which have caused great damage in the past. The dam forming the reservoir is of the concrete gravity type 293·6 m. long, 136·7 m. high 69·7 m. thick at the base and 5 m. thick at the crest. A brief history of the project is given and preliminary investigations of foundation conditions are described. The main features of the construction of the dam are described with many illustrations and plans.

No. 3736—August 20, 1937.

The United States Waterways Experiment Station at Vicksburg.

This article describes the Waterways Experiment Station at Vicksburg Mississippi, where experiments and studies are carried on by means of relatively large scale models for the purpose of solving river problems. Among the important problems that have been submitted for study are : flood control studies including levee investigations, effects of cut-offs and diversions, determination of limits of backwater, etc., navigation studies including revetment tests and contraction works ; hydraulic features of dams ; and tidal and wave action studies for harbours and inlets. The layout of the station and general arrangement thereof are described with details of the various buildings and other structures comprising the station. Illustrations of a number of important outdoor models at the station are given. A large indoor model of the famous Greenvile bends on the Mississippi River is also shown in the illustrations.

The Failure of Gravity Dams.

This article describes experimental investigations on the determination of tangential formation resistance of gravity dams carried out by Dr. Ing. N. Kelen at the Prussian Experimental Institute for Hydraulic Engineering in Berlin. The test procedure is described and brief details of the tests together with results obtained are given. In most of the tests, stone blocks were used to represent the rock foundations. On to these model foundations, concrete blocks of the same dimensions were built and after setting, the concrete was sheared from the stone by means of a special apparatus which is illustrated. The concrete specimens were constructed with two kinds of cements of the quick setting type. The aggregate was composed of river sand and gravel, graded according to Graf's curve. A relation between the normal force and shearing strength of the concrete was obtained and the results are tabulated. The influence of the kind of stone and its surface finish on the shearing strength of the concrete was also investigated. This article is based on a translation by Prof. Shulits of the Colorado School of Mines of the original article in German.

No. 3737—August 27, 1937.

The Chambon Reservoir, Isere, France. Rich.

This is in continuation of a previous article and gives details of construction operations of the dam. Arrangements for the supply of aggregates, cableways for the carriage of materials from the railway terminus to the site, water supply arrangements, and other features are described. The dam was constructed in twenty vertical sections of widths varying from 11·6 m to 20·2 m. The vertical face between sections was treated with bituminous emulsion. A sheet copper seal was placed between sections at a distance of ·7 m. from the upstream face. The dam is provided with a very complete system of drainage conduits. Several illustrations showing the dam under construction are given.

The Failure of Gravity Dams.

This article is continued from the previous issue. Further details of tests conducted are given and results are discussed. An interesting set of tests was conducted with the object of finding the influence of uplift on the shearing strength. Recommendations are made on the basis of the experiments as to the factor of safety against sliding to be provided in dams and the proper shape of the base of the dam.

THE GEOGRAPHICAL JOURNAL.

Vol. XC.

No. 4—October 1937.

Soil Erosion in South-Eastern United States. Morris.

The causes of soil erosion in the South-Eastern United States are discussed. The types of erosion met with are sheet erosion and gullying. The process of erosion is described. An exploitive and wasteful system of agriculture, and the removal of natural vegetation has resulted in the present erosion conditions. Remedies for the prevention of further erosion are suggested. These include reforestation, reversion of arable lands into pasture and introduction of new crops which may act as protectors of the soil.

THE IMPLEMENT AND MACHINERY REVIEW.

VOL. 62.

No. 741—January 1, 1937.

MOLE DRAINAGE. **Blackaby.**

This is a short note describing some methods of carrying out mole drainage in agricultural lands. Mole drainage is a cheap and effective method of drainage but only on land with a clay subsoil. There are three methods of carrying out the work namely by steam cable engine, by tractor winch, and by direct tractor haulage. Features of these methods are briefly described.

THE JOURNAL OF AGRICULTURAL SCIENCE.

VOL. XXVI.

Part I—January 1936.

THE TRANSPORT OF WATER THROUGH HEAVY CLAY SOILS. I. **Childs.**

This paper deals with the movement of water through heavy clay soil. The pressure conditions determining water flow in clay soils are mainly due to surface tension and not to gravity. A new theory is put forward according to which the water movement in clay soils follows the laws of diffusion. A general form of the diffusion equation is given. The equation implies that moisture can diffuse upwards as readily as it can downwards, given an equally favourable gradient. On the basis of this theory and starting with a given moisture content, expressions have been derived for moisture profile at any subsequent time in the absence of rainfall and irrigation, moisture profile at any subsequent time during rainfall, and the rainfall necessary to flush drains in the case of a drained soil. Various other expressions are also deducted mathematically and their physical interpretations are discussed.

THE TRANSPORT OF WATER THROUGH HEAVY CLAY SOILS. II. **Nicholson.**
Childs.

This paper deals with the applications of the theory discussed in the previous paper to practical cases in the field in order to obtain experimental evidence in support of the theory. A brief account is given of the authors' experiments in this connection and the results are discussed in relation to the diffusion theory of movement of water through clay soils. The conclusion reached is that a fairly satisfactory agreement is reached with practical experience under certain conditions, namely, that the soil shall be fairly moist (winter conditions) and that the drain efflux shall not be the first of the season in the case of drained soils. A few of the many points which call for further investigation relating to the theory are given.

Part 4—October 1936.

THE TRANSPORT OF WATER THROUGH HEAVY CLAY SOILS. III. Childs.

Water when applied to a dry soil, either directly or by means of placing wetter soil in contact with it, moistens the upper dry soil uniformly to some well defined depth and then remains stationary in a state of equilibrium, in spite of the moisture gradient at the lower surface of the moistened layer. In this paper the author attempts to show that the diffusion theory introduced by him in two previous papers satisfactorily explains the phenomena observed, and the alternative hysterisis theory advanced by Schofield is untenable. The experimental results of a number of investigators on this phenomenon are discussed and it is shown that the diffusion theory fits in very well with observed facts. The hysterisis theory is then briefly discussed and it is shown that the experimental results are inexplicable by this theory. The conclusion is that the theory of diffusion of water through soil accounts qualitatively for the water movement from wet to dry soil observed by American experimenters, and fits the best experiments numerically.

JOURNAL OF THE INSTITUTION OF CIVIL ENGINEERS.

No. 2—December 1937.

THE SUBSIDENCE OF A ROCKFILL DAM AND THE REMEDIAL MEASURES EMPLOYED AT EILDON RESERVOIR, AUSTRALIA. Knight.

See under " Water and Water Engineering " February 1938, in this Bulletin.

DOVER TRAIN-FERRY DOCK. Ellson.

Features of the design and construction of the new dock at Dover for ferry vessels carrying trains across from Dover to the Continent are described in this article. (See also page 17 of Quarterly Bulletin No. 4.)

The object of this paper is to present a simple method based on first principles for determining the depth at any point in a channel where the velocity is increasing or decreasing in magnitude. The existing formulæ for flow in a channel suffer from one common limitation that the water is taken to enter and leave the channel at such a depth that a uniform velocity is maintained throughout its length. In short channels these conditions are rarely experienced in practice. The need for a formula to determine the contour of the water surface of a channel which is not long enough to establish a uniform velocity has been realized by Babbit and Bakhmeteff. The work of the latter in particular forms a valuable contribution to the science of Hydraulics and is the basis of the conception by the author of the subject of this paper.

The author commences with a general discussion of the energy relations in the flow of water in a channel. Specific energy is the sum of pressure energy and kinetic energy. The depth at which specific energy is a minimum is the critical depth. Flow at a depth greater than critical depth is tranquil and at a depth less than critical depth is rapid flow. Effects of change of slope of invert from gradual to steep and *vice versa* are discussed. In the latter case the flow is characterized by the formation of the hydraulic jump and the standing wave depending on the conditions of flow. Having determined the type of flow that will result from a given flow in a predetermined channel from these considerations, the distance between various depths can be found and the author proceeds to show how this can be done illustrating his method with a number of examples. Three types of channels namely trapezoidal, rectangular and circular conduit section are dealt with. From slope and energy considerations in various sections of a channel, the distance between different depths has been worked out, and the results are given in tabular form. Curves for water surface can be plotted from these tables, giving depths at various points along a channel. Curves are also reproduced giving the height of hydraulic jump which occurs at the change from steep to gradual slope for the three types of channels mentioned above. An example is worked out to show how the position at which the hydraulic jump occurs in a channel changing from steep to gradual slope can be determined from water surface curves obtained from the method described above and the hydraulic jump curves reproduced. An application of the principles discussed in the paper can be found in the design of stilling pools. In river works it is often necessary to discharge quantities of water at a high velocity into the river with danger of scour. Having arrived at the depth of flow in the channel just prior to the discharge, by the procedure described, the height of the jump can be read off from the curves and a barrier may be constructed sufficient to back up the water to the required height to form the jump.

A model of a rectangular channel 10 ft. wide was constructed to 1/20 scale and measures flows of water were passed down it at different slopes of the invert. The depths of water were observed at equal intervals and were plotted along with the depths theoretically calculated according to the author's method. The resulting curves which are reproduced show good agreement between the actually observed and theoretically obtained depths.

ENGINEERING RESEARCH.

RESEARCH IN ENGINEERING AT OXFORD UNIVERSITY.

A study of the formation of standing waves in the divergent portion of a venturi flume is being made. The discharge of such a flume under free flow and drowned conditions has been studied. Another research concerns discharge over circular weirs.

NOTES ON RESEARCH PUBLICATIONS.

BRICK, CEMENT AND CONCRETE.

The wick test of efflorescence of building brick is described in *U. S. Bur Standards J. Research, 19, 105.*

WATER SUPPLY AND WATER POWER.

A note on the coefficient of discharge of automatic syphon spillways is given in *Annales des Ponts et Chaussees, 107-i, 733.*

Experiments on a small scale model of a sector weir are given in *Rev. Gen. de l'Hydraulique 3 (16) 193.*

No. 3—January 1938.

AIR-RAIDS AS THEY AFFECT THE WORK OF THE CIVIL ENGINEER. Garforth.

This is a lecture dealing with the passive defence measures advocated by the Government through the medium of the Air Raid Precautions Department in the event of war, and endeavours to show in what respect these measures are of particular interest to engineers, and how engineers can materially assist in their carrying out by the judicious design of structures. Various types of bombs and their effects are briefly described and protective measures are discussed. Features in multi storey buildings which are advantageous and disadvantageous from the point of view of protection are described. Points to be considered in location of shelter accommodation in a building and in the methods of construction of shelters in new buildings are discussed.

THE RECONSTRUCTION OF CHELSEA BRIDGE. Buckton. Fereday.

This paper deals with the replacement of an 80 year old suspension bridge by a modern structure. The old bridge had piled foundations, fixed portal braced towers, iron suspension chains, massive shore anchorages and cast iron ornamentation. The new bridge has deeply founded solid piers, hinged towers without portals. Self anchored cables and no ornamentation. The self anchored type of suspension bridge consists of deep stiffening girders running from end to end and the cables after passing over the towers are anchored to the ends of the stiffening girders. This type, on account of the heavy stiffening girders has great stiffness and is free from vibration. The theory of self anchored bridges is briefly discussed and the loads adopted are given. The piers were designed of mass concrete faced with granite above low water level. They are founded on open concrete foundations within sheet steel piled cofferdams. The stiffening girders were constructed of high tensile steel. Details are given of suspension cables, towers, floor system, and other accessory parts and construction procedure is described. Observations were made on the settlement of the piers both during construction and after the bridge had been opened to traffic, and the method is described. A settlement curve showing the settlement of one of the piers under progressive application of dead load is given. Records of the internal temperature of the concrete during the period of setting and hardening were taken at certain points in the piers. The results of these observations are depicted graphically. (See also Quarterly Bulletins Nos. 1 and 4, pages 5 and 15 respectively.)

AN APPLICATION OF THE PRINCIPLE OF SUPERPOSITION TO CERTAIN STRUCTURAL PROBELMS. Pippard.

"Hooke's law states that if a springy body be loaded the resulting displacements are proportional to the forces which produce them, and experience shows that many engineering structures obey this law. It is a direct corollary that the effect produced upon such a structure by a number of loads which act simultaneously is the same as the algebraic sum of the effects produced if the loads are assumed to act separately. This is the Principle of Superposition which is well known as a theorem although its practical application to the analysis of structures is sometimes not fully appreciated. The object of the present paper is to show how, by its help, comparatively simple solutions can often be obtained of problems which are somewhat intractable by more direct methods of attack. The method described is applicable only to structures which are symmetrical about a centre line."

The author discusses the principle of the theorem and explains the method of application of the principle to a number of structure with the help of examples. These examples illustrate how the principle can be applied to the solution of typical problems relating to encastré beams, elastic arches, bow girders and braced frames. A structure with multiple loads can also be analysed by this method and this is illustrated by an example.

RESEARCH WORK IN ENGINEERING AT THE UNIVERSITY OF LEEDS.

CIVIL ENGINEERING.

During the past few years work has been conducted on the elastic and plastic strains in plain and reinforced concrete beams and arches. The distribution of horizontal, vertical and shearing stresses has been observed along vertical sections of beams, and the influence of concentrated loads on the stress distribution has been noted. The results show that stresses in the tension and compression reinforcement under working loads are in fair agreement with those calculated whilst the stress in shear reinforcement, whether in the shape of stirrups or turned up rods, is rarely as much as 75 p. c. of that calculated. The type of shear reinforcement is found to have a marked influence on the magnitude of the deflexion.

NOTES ON RESEARCH PUBLICATIONS.

Impermeability of concrete and brick structures and consideration of integral and surface water proofers. *Ciment Arme, 19, 90.*

Rigid damp-proof courses in brickwork. *Building, 12, 264.*

Earthquake resistant reinforced brick masonry as a structural material *Brick and clay Record, 90, 323.*

No. 4—February 1938.

THE CREEP OF PORTLAND BLAST-FURNACE CEMENT CONCRETE. ROSS.

The author carried out a series of tests on the creep or time deformation of Portland blast-furnace cement. The apparatus used in the tests and the results of tests with concrete of various mixes of Portland blast furnace cement are described in this paper. The results indicate that Portland blast furnace cement concrete showed markedly greater creep, it being 64 per cent. greater than that for normal Portland cement concrete at 118 days. In view of the large creep of this cement it follows that very high steel stresses must exist in many structures in which it has been used. In conclusion the author considers that for conditions demanding the minimum deformation, aluminous or rapid hardening cements should be used. For the avoidance of cracking the use of Portland blast-furnace cement is indicated. Reinforced structures of this material have been found to be very free from this defect, a result which follows directly from the large creep. Shrinkage stresses in Portland cement and Portland blast-furnace cement are of the same order and therefore in the case of the latter greater relief of shrinkage stresses must be afforded by creep in tension. Portland blast furnace cement has been used for recent dams in Germany, and whilst other considerations such as temperature effects may have influenced the choice, it is in this form of construction that its major advantage must lie.

SUPPLEMENTARY NOTES OF FLOW THROUGH MODEL SLUICES. Addison.

During the past 15 years a good deal of experimental work has been carried out in Egypt on the flow of water through model sluices. The work done covers the following conditions of flow :

(1) Free flow through high head sluices.

(2) Submerged flow through high head sluices.

(3) Submerged flow through low head sluices.

No records were available of any work on free flow through low head sluices and the author carried out some experiments in the laboratory of the Royal School of Engineering at Giza on this subject. These experiments are described in this paper. In part I of the paper the author compares the results of experiments on submerged high head sluices with the results of his own experiments on submerged low head sluices carried out previously. In part II the author describes his experiments with a 1/25 model of the Assuit barrage on flow through low head sluices, and discusses the results. The main conclusions arrived at are :

(1) The experiments on high head submerged slucies and those on low head sluices gave results whose general tendencies are mutually in agreement.

(2) Under free flow conditions all the experiments on various types of openings yielded results that could be represented by straight line graphs.

SHEARING STRESSES IN GRAVITY DAMS. Leliavsky.

In his introductory remarks the author briefly discusses some of the theories pertaining to stresses and strains in structures and traces their development. He shows that for masonry and concrete, shearing stresses are more dangerous than tension. The safety of dam design depends not only on the value of the maximum shearing stresses but also and essentially on the manner in which they are distributed over the different points of the cross section. The computation of shearing stresses at various points of a dam profile by the usual methods leads to

certain difficulties. The author in this paper proposes a comprehensive general formula and a speedy graphical method by means of which the intensities of shearing stress on any horizontal plane of the dam can be calculated as easily as the normal stresses. The methods at present in use for the computation of shearing stresses in gravity dams are first discussed and the inherent difficulties are shown. The author then presents his own method. The general formula is first derived and its application in practical dam designing is explained. The graphical method for the computation of shearing stresses is next described. Application of the general formula to other types of structures such as barrages, weirs and regulators is illustrated by an example of a pier in a barrage. The results of calculations carried out according to this formula for the piers of the Assuit Barrage in Egypt before its strengthening are shown.

NOTES ON RESEARCH PUBLICATIONS.

Settlement of Foundations, *Schweiz. Bauzeitung, 110, 255.*

Measured and computed temperatures of concrete at the Norris Dam, *Am. Conc. Inst. J. 9, 117.*

Observations on the movements of sand in the Lower Rhine, *De Ing. (Bouw en Waterbouw), 52, 167.*

The mathematics of minimum voids in concrete aggregates, *Concrete (New York) 45 (10).*

NATURE.

VOL. 139.

No. 3517—March 27, 1937.

BASE EXCHANGE CAPACITY AND CLAY CONTENTS OF SOILS. **Mitchell. Muir.**

Results of some investigations on the base exchange capacity of soils relative to their clay content are discussed herein.

No. 3520—April 17, 1937.

EDDY-CURRENT RESISTANCE IN FLUIDS DUE TO ROTATION. **Grant.**

No. 3522—May 1, 1937.

WATER-POWER DEVELOPMENTS IN THE UNITED STATES. . **Cunningham.**

The progress of water power development in the United States is briefly reviewed. Four outstanding hydroelectric works recently undertaken in America are described in a series of articles of which this is the first. The present article describes the Boulder Dam.

No. 3524—May 15, 1937.

WATER-POWER IN THE UNITED STATES. Cunningham.

Continued from a previous issue. A brief description is given ot the Grand Coulee Dam and the Bonneville Dam projects of the United States Bureau of Reclamation.

No. 3528—June 2, 1937.

WATER-POWER IN THE UNITED STATES. Cunningham.

This article is in continuation of two previous articles and describes the Norris and Wheeler Dams of the Tennessee Valley Project. Both are concrete gravity dams, the former 265 ft. high and the latter 72 ft. high. Spillway structures and power plants are described in brief.

No. 3547—October 23, 1937.

RIVER FLOW AROUND BENDS. Cunningham.

In the summary of a lecture on " Rivers " delivered in connexion with the meeting of the British Association by Mr. R. K. Gresswell published in this journal the following statement was made: "In turning a corner the speed on the outside of the curve is always greater than that on the inside. This results in the water on the outside being able to take an additional load and so erode the bank". The author of the present note states that Prof. Thomson's investigations showed that the erosion is not due, as alleged, to greater velocity on the outside of the curve. On the contrary the velocity on the outside of the curve is less than on the inner side. He quotes as follows from the article on Hydromechanics by Prof. Unwin in Encyclopedia Britannica (1881).

" When water moves round a circular curve under the action of gravity only it takes a motion like that of a free vortex. Its velocity is greater parallel to the axis of the stream at the inner than at the outer side of the bend. Hence the scouring at the outer side of the bend and the deposit on the inner side is not due to mere difference of velocity of flow ; but in virtue of the centrifugal force the water passing round the bend presses outwards and the free water surface in a radial cross section has a slope from the inner side upwards to the outer side.......The water immediately in contact with the rough bottom and sides of the channel is retarded and its centrifugal force is insufficient to balance the pressure due to the greater depth outside of the bend. It therefore flows inwards carrying with it detritus which is deposited at the inner bank."

The above explanation of Professor Thomson's was completely verified by experiment and has long been known to river engineers.

PROCEEDINGS OF THE ROYAL SOCIETY.

VOL. 158.

No. 895—February 3, 1937.

MECHANISM OF THE PRODUCTION OF SMALL EDDIES FROM LARGE ONES.	Taylor. Green.

This is a mathematical investigation of the theory underlying the process of grinding down of eddies produced by solid obstructions into smaller eddies which is a fundamental problem in turbulent motion.

VOL. 159.

No. 898—April 1, 1937.

CONFORMAL TRANSFORMATION WITH THE AID OF AN ELECTRICAL TANK.	Bradfield. Hooker. Southwell.

The flow of a steady electric current in a flat sheet of uniform conductivity is analogous to the flow of an inviscid liquid moving of steadily in two dimensions and both are governed by the same type of equation. Advantage has been taken of this analogy to solve the hydrodynamic problem in cases of mathematical difficulty by exploring the distribution of potential in an electrolyte of uniform depth contained within an electric tank. Part I of the paper deals with the theory and part II with experimental details.

No. 899—April 15, 1937.

THE SIMILARITY THEORY OF TURBULENCE, AND FLOW BETWEEN PARALLEL PLANES AND THROUGH PIPES.	Goldstein.

In this article, Karman's similarity theory of turbulent flow for two dimensional parallel mean flow is critically discussed. The theory is applied to find the shearing stress for two-dimensional parallel mean flow and the resulting equation of motion is of the same form as the equation of the Momentum Transfer Theory in Prandtl's form. If however the rate of communication of momentum to unit volume is taken from the theory the equation of motion is the same as that obtained in Taylor's Vorticity Transfer Theory. The two forms of the theory are compared with experiments and it is found that the first form agrees much better than the second. The theory is then developed in both forms for parallel mean flow symmetrical about an axis and the resulting equations are solved for flow through a circular pipe. In this case the second form agrees much better with experiments than the first. It is shown that there is no logical justification for the application of the results of two dimensional parallel flow to pipe flow.

FLOW IN PIPES AND BETWEEN PARALLEL PLANES. **Taylor.**

The author refers to the previous paper by Goldstein and discusses the assumptions made. He then refers to his own Vorticity Transfer Theory and discusses the assumptions made therein. He goes on to apply his theory to pressure flow in pipes or between parallel plains and compares its agreement with experimental results. It is shown that the Vorticity Transfer Theory is in better agreement with observation than the Momentum Transport Theory for pipe flow while for flow between parallel planes, there is nothing to choose between the two theories.

THE FLOW UNDER GRAVITY OF AN INCOMPRESSIBLE AND INVISCID FLUID THROUGH A CONSTRICTION IN A HORIZONTAL CHANNEL. Binnie. Hooker.

In this paper a theory of the flow in a horizontal channel of varying cross section is developed in a manner exactly parallel to that employed by Osborne Reynolds for the flow of a compressible gas through a nozzle of varying cross section, the two cases being analogous. Experimental investigations made to test this theory are described and it was found that the results obtained did not agree with the theory. A second theoretical method was then developed on the basis of the analogy that exists between the flow of an incompressible fluid through a constriction and the two dimensional flow of a compressible gas through the same constriction, and the results agreed with the experiments.

VOL. 162.

No. 911—October 15, 1937.

THE SUSPENSION OF SOLIDS IN A TURBULENT STREAM. Richardson.

This paper deals with the problem of distribution of solid material in a turbulent stream. Theoretical aspects of the problem are discussed. A technique is developed by means of which relative quantities of solids carried in suspension at different levels in a water channel having a bed of graded sand can be measured. Experiments made in an artificial channel with the equipment used are described and results are discussed. The application of the results obtained to natural streams is then investigated and experiments made in this connection on the River Tyne are described. Finally an apparatus constructed by the author for measuring relative silt concentrations in a river is described.

THE ROYAL ENGINEERS JOURNAL.

Vol. LI.

December, 1937.

Engineer Work in the Mohmand Operations, 1935.

Engineering operations in connection with Mohmand expedition in 1935 are described in this article. The works included water supply and the construction of an eight mile pipe line, the construction of a road over the Nahakki Pass and the maintenance of the existing Gandab road in the area. Difficulties encountered and the means adopted to overcome them in each case are described. Explorations by the field engineer to locate sources of water supply, laying of the pipe line under difficult conditions, and pumping arrangements are described. The road over the Nahakki Pass was to be 15 ft. wide on the straight, and 20 ft. wide at bends and the ruling gradient was 1 in 20. Alignment of the road, blasting operations, construction of culverts and causeways, and consolidation and surfacing of the road are briefly described. The surface was consolidated with a 1½ inch layer of gravel watered and rolled. The Gandab road is twenty miles long, part of which is an earth road 35 ft. wide stabilized with gravel and the remainder a tortuous hill road twenty feet wide. The repairs to the earth road consisted of laying screened shingle on the surface which was consolidated by traffic. Shingle with sharp sand screened to exclude stones over ¾ inch in diameter proved to be the most satisfactory.

Strip Roads in Southern Rhodesia. Bader.

This article contains a brief description of a new method of road construction in Rhodesia to meet the demand for good roads suitable for high speed motor traffic at a minimum cost. About 2,500 miles of roads in Rhodesia are lightly gravelled with granite or diorite materials but the surface is loosened by traffic in dry weather. Various methods of improving these gravel roads as cheaply as possible were considered and ultimately it was decided to provide two durable all-weather strips 2 ft. wide with a space of 2 ft. 9 inches between them. These strips would be used for high speed motor traffic. The existing gravel road is shaped to true camber and two trenches are cut on each side of the centre line 2 ft. wide, 3 inches deep and 2 ft. 9 inches between the internal edges. The trenches are filled to ½ inch above road level with clean broken stone of 2″ to 2½″ side which is rolled and sprayed with bitumen at the rate of ¾ gallon per sq. yard. A layer of ¾ inch stone is applied on this and a seal coat of bitumen is applied finally on top followed immediately by a layer of ¼ inch chippings well brushed in and rolled. Regulations have been passed whereby steel tyred vehicles are prohibited on strips. The cost of the strips is about £350 per mile.

GRASS PLANTING AS A MEANS OF TIDAL LAND RECLAMATION. Le Sueur.

This article describes the use of a hybrid grass known as Spartina Townsendii for building up the ground on a sea coast to prevent coastal erosion. The planting of this grass encourages collection of silt round the clumps. The grass flourishes and builds up the level of the coast. It spreads vigorously into new ground down to 4 to 6 ft. below high water mark and converts soft mud flats into hard ground on which cattle can walk.

REVIEW OF MAGAZINES.

RIVISTA DI ARTIGLIERIA E GENIO, June 1937.

Captain Mantia in an article in this issue shows how a study of the geological formation of the ground and of the surface vegetation may indicate the presence of subsoil water suitable for drinking purposes.

REVUE DU GENIE MILITAIRE, May-June 1937.

Captain Choquet in an article describes a temporary bow string girder bridge built of rafters and steel trope on the Tarron system with modifications. The gap to be spanned was 90 ft.

REVUE DU GENIE MILITAIRE, July-August 1937.

A well illustrated article by Lieut.-Colonel Guct described wooden lattice girder bridges of various types.

VOL. LII.

March, 1938.

GUL KACH BRIDGE. Barton.

Description is given of a 174 ft. span reinforced concrete arch bridge with a viaduct consisting of five 47 ft. spans of reinforced concrete beam and slab. The arch has two ribs with a span of 174 ft. and rise of 30 ft. The ribs are 14 ft. 3 inches centre to centre supporting a reinforced concrete deck by means of columns and hangers. The abutments consist of solid reinforced concrete founded on rock. The ribs were built on the Melan system. The five span reinforced concrete viaduct consists of two continuous beams 8 ft. apart centre to centre carrying a slab 13 ft. wide and 6½ inches thick. The piers of the viaduct are of solid stone masonry in cement mortar. Brief details of design are given and construction procedure is described.

DEMOLITION OF REINFORCED-CONCRETE BRIDGES. Spottiswood.

Some general principles of demolition of reinforced concrete bridges are discussed in this article. A number of actual examples are given and the procedure of demolition is explained.

SOIL STABILIZATION AT LYDD. Behrens.

The stabilization of an earth road with a bitumen emulsion is described in this article. The equipment and materials used and the procedure are given.

THE SURVEYOR AND MUNICIPAL AND COUNTY ENGINEER.

VOL. XCI.

No. 2359—April 9, 1937.

MODERN TREATMENT OF FOUNDATIONS ON DIFFICULT SITES. Geen.

Some problems relating to foundations of buildings on difficult sites and the methods of dealing with them are discussed.

RIVER FLOW RECORDS AND WATERWORKS DESIGN. Henderson.

This is an extract from the Presidential Address to the Scottish Branch of Institution of Water Engineers. The greater need of measuring river flows for the purpose of determining the capabilities of watersheds in the design of waterworks is emphasized.

WATER AND WATER ENGINEERING.

VOL. XL.

No. 488—January 1938.

EDITORIAL NOTES.

THE THAMES ESTUARY.

Lt.-Col. W. Butler in the course of a public lecture drew attention to the importance of the Thames Estuary in relation to health conditions in London. Pollution of the estuary above and below the sewage outfalls of the London County Council is now very serious, and sewage pollution is carried upstreams through London by tidal resurgence. He urged the necessity of providing a barrage to prevent resurgence of the contaminated water.

SOME FEATURES OF FLOOD CONTROL AND STREAM FLOW REGULATION ILLUSTRATED IN THE THAMES AND SEVERN CATCHMENTS. Williams.

This is a paper presented to the Institution of Sanitary Engineers and deals with flood control and stream flow regulation on the

Thames and Severn Rivers. (See pages 34 and 35 in Quarterly Bulletin No. 8.)

VARIATION IN LOSS OVER CATCHMENT AREAS.

PERCOLATION FROM CATCHMENT AREAS. Lloyd.

This is the second instalment of an article first published in November 1937 issue of the Journal. It deals with rain water lost during percolation from catchment areas. Percolation is defined as the depth of rain water in inches which soaks away through the earth, a portion of it being entirely lost to the catchment area. Vermmeule's and Penck's methods of estimating the total loss over a catchment, which are of long standing, are discussed and the defects of these methods are shown. The author's method described in the previous article is an improvement on the older methods. Vermeule's and Penck's methods fail outside a limited range of rainfall because they are based on the assumption that the relation of evaporation loss to rainfall is linear while actually it is curvilinear. Both methods omit loss during percolation and insolation, the latter term denoting the exposure of an inert mass of water to the rays of bright sunshine. The above omissions have been taken account of in the author's method.

FOREIGN AND COLONIAL.

A WATERWORKS IN CHINA.

In a paper by Mr. F. W. G. Clark, Waterworks Engineer to the British Municipal Council of Tientsin read before the Junior Institution of Engineers, details of the new waterworks for Tientsin are briefly described. The sources of supply are a number of boreholes from which the water is lifted by compressed air pumps to a service reservoir. One of the borings which is 460 ft. deep yields 250,000 gallons per day. The water obtained is of high quality and no treatment is necessary.

No. 489—February 1938.

EDITORIAL NOTES.

THE PROPOSED THAMES BARRAGE.

Plans for the construction of a barrage across the Thames at Woolwich are to be investigated by the Port of London Authority. The enquiry opens on March 29, 1938 and is to be conducted by Sir Henry Maybury. The barrage would be 1,500 ft. long with roadway and rail track and will have six locks. At present sewage entering the Thames is carried upstream to Kew at high tide. This would be stopped by the proposed barrage.

SALT WATER LEAKAGE INTO WELLS.

One of the methods adopted by the U. S. A. Geological Survey for locating salt water leakage into wells is the electrical conductivity method. The method consists of lowering a pair of insulated electrodes into the well and measuring the resistance of the water between them with the Wheatstone bridge. In water with low chloride content a direct current of low voltage is applied and the current flowing between the electrodes is measured by a milliammeter. The instruments showed a marked increase in the conductivity of the water as the electrodes passed from fresh to salt water thus indicating the location of the leaks.

BRIDGEWATER CORPORATION WATER SUPPLY. Grace.

This article describes certain works constructed to provide an additional supply of water for the Corporation, the existing works being inadequate to meet the increased demand. These works include :—

(1) A storage reservoir of 200 million gallon capacity formed by a dam across Durleigh brook.

(2) A new filter house and pumping station.

(3) A 14 inch diameter steel pumping main about 3¼ miles long leading from the pumping station to the service reservoir.

(4) A reinforced concrete service reservoir of 1 million gallon capacity.

(5) A gravitation main leading from the service reservoir to a factory in Bridgewater to which the Corporation was under a contract to supply 1 million gallons of water per day.

Of the above works the Durleigh dam and pumping station are under construction. This article describes in some detail the works in connection with a canal crossing and a river crossing of the gravity main from the service reservoir to the factory. The pipe line is carried across the canal which is 34 ft. wide in the form of an arch which is entirely self supporting the horizontal thrusts being taken by concrete abutment blocks cast round the vertical bends at each end of the crossing. In the case of the river crossing the pipes are laid in trench dug in the river bed. The river is 150 ft. wide at this point. Main features of the design of these works and erection operations are described in detail. Various forms of crossings were examined before adopting the final types constructed, and the disadvantages of the rejected proposals are discussed.

THE SUBSIDENCE OF A ROCKFILL DAM AND THE REMEDIAL MEASURES EMPLOYED AT EILDON RESERVOIR, AUSTRALIA. Knight.

This is the summary of a paper read before the Institution of Civi Engineers. The Eildon reservoir is situated below the junction of the Delatite and Goulburn Rivers about 90 miles north east of Melbourne. The dam forming the reservoir was completed in 1927, is 3,200 ft. long including a concrete spillway section of 682 ft. long and is 140 ft. high. It is provided with a reinforced concrete core wall supplemented on the upstream side by a mass of clay puddle, and contained 1¼ million cubic yds. of rockfill. In 1929 the upstream rockfill subsided exposing the core wall to a maximum depth of 28 ft. in a length of 1,400 ft. from the spillway end of the dam. This paper describes the events leading up to the subsidence, outlines its probable cause and gives a full description of its effects on the structure. The subsidence was considered to be due to the pressure of clay puddle against the rock mass. The upper part of the core wall was exposed on the reservoir side as stated above and was liable to overturning action from the weight of the rockfill on its downstream side. The core wall and reinforced concrete outlet tower were deflected, causing some cracks and change of shape. The spillway capacity was also considered to be insufficient to discharge the largest flood that might be expected. The Board of enquiry appointed to examine the work after the accident recommended that the subsidence of the rock on the upstream side should be made good by the deposition of additional rockfill placed so as to stabilize the bank, and that adequate drainage should be provided under the base of the downstream side of the embankment. Cracks in the core wall were to be repaired and staunched on the upstream side. The outlet tower was to be strengthened and the discharge pipes extended and provided with downstream outlet valves. The execution of these works is described.

LOSS OF HEAT AT ELBOWS. Whitby.

This article discusses the loss of energy due to a change of direction of flow in elbows. An elbow causes an increase in the maximum velocity and a redistribution of velocities. The sudden change of direction causes a contraction followed by an enlargement of the section of flow. Previous investigations show that the loss of energy is proportional to v^2. Expressions for the loss of energy obtained by some investigators are given, and are of the form

$$h = \frac{k. v^2}{2g}$$

where h is the loss of head, k a constant and v the velocity. The author also describes some experiments carried out by him on the subject and discusses the results. The general conclusions arrived at by the author is that the loss of head due to an elbow in a pipe is proportional to the square of the velocity. The numerical value of the constant occurring in the expression for the loss depends upon the condition of the fluid just before reaching the elbow. The condition of the fluid is affected by the formation of eddies due to change of path.

VARIATION IN LOSS OVER CATCHMENT AREAS. EVAPORATION, EVAPO-TRANSPIRATION AND ABSORPTION.

Lloyd.

This is the third instalment of the article and deals with the mechanism by which moisture is lost from rain water, principally the evaporation deferred by infiltration. Some moisture is evaporated directly in the air and some is taken by plants and transpired. According to biologists about 90 per cent. of the moisture taken up by plants is transpired through the pores of the plant. The removal by vaporisation of transpired moisture is called evapo-transpiration. Moisture is also held in suspension in porous soils and a portion of it is exsiccated. The amount of this exsiccation depends on the volume of water held in the interstices of the soil, and the rate on weather elements. These are the losses by evapo-transpiration and exsiccation during percolation. Thus there are two modes of evaporation, the immediate evaporation occurring while the surface is wet by a rain shower followed by evapo-transpiration and exsiccation which constitute evaporation deferred with respect to the rain shower. The evaporation also depends on the mean annual temperature, insolation, humidity and wind.

The author proceeds to analyze Vermeule's equations for loss in which the loss is a linear function of the rainfall, and suggests that constants in the series of equations are associated with immediate evaporation loss. He then refers to the analyses of loss over Vyrnwy Catchment area based on the records for a long period and shows that the loss due to insolation per 100 hours departure from 1450 hours sunshine adopted by him in his method (See page 44, Bulletin No. 8) is justified. The rate of evaporation from a free water surface is then considered and previous investigations on this subject are referred to. Equations giving evaporation from a free water surface given by various authorities are analyzed and discussed. Since 90 per cent. of the moisture taken up by plants is vaporized and 10 per cent. is entirely lost, it is concluded that evaporation from a wet surface is 105 per cent. of the rate of evaporation from a free water surface. Finally the author obtains an expression for evaporation loss taking all the factors into consideration and gives a typical curve showing the relation of the evaporation loss to rainfall.

A graph showing relation of total loss to rainfall for three areas in England under exactly similar conditions of rainfall, temperature and sunshine from results obtained statistically is reproduced. The variations in the curves for the three areas are in the opinion of the author due to difference in infiltration capacity of the geological formation in each area which was not taken account of in assessing the loss.

FOREIGN AND COLONIAL.

CEYLON HYDRO-ELECTRIC SCHEME.

The Ceylon State Council has voted Rs. 5 lakhs for the construction of the first stage of the Laxapana Hydroelectric scheme which is estimated to cost altogether Rs. 24,000,000.

GANGES ELECTRIC GRID.

Two power stations opened recently near Meerut mark the completion of the Ganges Canal Hydroelectric Scheme which will supply electricity to 88 towns, and power for lifting water from rivers and tube wells and to energise agricultural machinery. The grid has an output of 29,000 k. w. distributed by 4,000 miles of transmission lines to 1,600 substations.

No. 490—March 1938.

SOIL MOISTURE EVAPORATION. Chaxel.

This paper deals with investigations on the relations between evaporation and meteorological elements in the immediate vicinity of the bed of soil from which evaporation is taking place. Influence of temperature, humidity, wind, and barometric pressure on evaporation was observed by means of an apparatus which is described. Conclusions from these investigations are given.

THE SUBSIDENCE OF A ROCKFILL DAM AND THE REMEDIAL MEASURES EMPLOYED AT EILDON RESERVOIR, AUSTRALIA.

A report of the discussion on the above paper presented to the Institution of Civil Engineers is given.

DEMAG NEWS.

VOL. XI, B.

No. 3—November 1937.

THE NEW DIPPER SHOVEL EQUIPMENT OF THE DEMAG UNIVERSAL EXCAVATORS.

A description is given of Demag Universal Dredgers and shovel excavators of various types with recommendations for their use on different types of work. Practical hints regarding their use are given.

FORSCHUNGSHEFT.

Vol. 3.

No. 356—September/October 1932.

Gesetzmäbigkeiten der Turbulenten Strömung in Glatten Rohren. (Trans.—Laws of Turbulent Flow in Smooth Pipes). **Nikuradse.**

Experiments were carried out by the author with the object of determining the relationship of turbulent flow in smooth pipes for the largest range of Reynold's number. These experiments are described in detail. The experimental data are analysed and certain relationships between the various factors involved are obtained. In the introduction, the works of previous investigators are discussed critically and it is shown that the results obtained by them were not sufficient to clear the ideas about turbulence problems in pipes.

(English translation of the article is also available in the Board's library.)

VIZUGYI KOZLEMENYEK.

(In Magyar but containing English summaries.)

Vol. XIX.

No. 2—1937.

Repairs of the Spillway Sluice at Gibart in 1936. **Sikhegyi.**

This sluice was built in 1903 without proper sheet piling. During the flood in 1936 its right bank retaining wall cracked, and beneath and behind it a large cavity was formed. On account of the high water stage the first repairs were made by sinking sacks filled with concrete, and then under their protection by underwater concreting. Later on, the trouble was put to an end by sheet piling and by filling up the cavities with cement mortar.

Construction of the New Outfall for Sewerage at Budapest. **Demeter.**

The new outfall works are described. The foundations consist of reinforced concrete caissons and the outfall pipe is a double pipe of reinforced concrete each with a cross sectional area of 3 sq. metres. The pipes were taken below the river bottom a distance of 156 m from the bank at a depth of 11 m. below middle water.

LE GENIE CIVIL.

VOL. CXI.

No. 2—July 10, 1937.

NOUVEAU DISPOSITIF DE DESSABLEMENT DES CANAUX. (Trans.—A new method of cleaning canals). **Kimpflin.**

This article describes a form of silt ejector for a canal for the continuous evacuation of solid materials. It consits of an orifice placed on the inside of a curved portion of the channel where transverse flow of the lower layers of water causes the silt to accumulate. The form of curve in the canal necessary for the satisfactory working of the arrangement, the fixing of the orifice in the bend, the shape and dimensions of the orifice are described with mathematical calculations for their determination. A numerical example is worked out to illustrate the procedure of design. Various tests were made with this type of ejector at the school of Hydraulic Engineers at Grenoble and the tests showed that 99·5% of the solid material carried could be removed with the loss of 1 to 4% of water.

(English translation of the article is also available in the Board's library.)

REVUE GENERAL DE L'HYDRAULIQUE.

(In French.)

No. 17—September/October 1937.

Nothing of interest to Irrigation Engineers in this issue.

INGENIERIA.

VOL. XI.

No. 2—February 1937.

REPORT ON THE EFFECT OF "WEED" IN THE MAIN CANAL OF THE NATIONAL IRRIGATION SYSTEM No. 5, AND METHODS OF COMBATTING IT. (In Spanish.) **Bistrain.**

This article describes an investigation into the effect of weed growth on a canal in Mexico, and the methods adopted to eradicate it. A botanical classification of the weeds is given, and the extent to which they reduce the capacity of the canal is then dealt with, together with the effect on the rugosity coefficient. The economic aspect of the problem is then considered, and is followed by a description of the methods used to combat the evil. These include mechanical, chemical, physiological and miscellaneous methods. The design of a special disc rake for clearing the weeds is illustrated.

AGRICULTURE AND LIVE-STOCK IN INDIA.

VOL. VIII.

Part I—January 1938.

SCIENCE AND PRACTICE OF AGRICULTURE IN INDIA. **Viswanath.**

Extracts from the presidential address to the Agricultural Section of the Indian Science Congress are given herein. Characteristics and reactions of soils in relation to agriculture are discussed. Soil cultivation methods and their effects on the soil are dealt with. Fertilizers and manures are discussed and the importance of organic manures for the soil is emphasized. The beneficial effects of green manure are explained. In conclusion it is stated that the Royal Commission on Indian Agriculture in India have recorded that the system of agriculture and agricultural practices in vogue in India stand unchallenged by modern research. Research therefore should concern itself more with details of existing practices than with the evolution of wholly new methods.

CURRENT SCIENCE.

VOL. VI.

No. 7—January 1938.

THE INDIAN SCIENCE CONGRESS SILVER JUBILEE.

This is an editorial note on the Silver Jubilee Session of the Indian Science Congress held in Calcutta in January 1938 and mentions the part played by the Congress in scientific progress in India.

THE SILVER JUBILEE OF THE INDIAN SCIENCE CONGRESS. Fowler.

The author in this article gives his impressions of the Jubilee Session of the congress. A discussion on the attractive and important subject of River Physics did not actually take place as the papers, although of great interest and value, were too long and too specialist to permit of any immediate consideration.

THE INTERNATIONAL COMMISSION OF SNOW.

The International Commission of Snow authorised by the International Association of Scientific Hydrology at Lisbon in 1933 held its first meeting in Edinburgh in September 1936. The subjects dealt with included among others—measuring precipitation, snow surveying and influence of snow on run-off. The problems assigned for investigation and report in 1939 include: (1) Permeability of snow and its capacity to retain water, (2) Influence of snow and ice on stream-flow. Explanation of the cause of the abnormal and seemingly persistent low minimum flow in the Punjab, India, was one of the problems preferred to the Commission.

No. 8—February 1938.

TESTING LABORATORY EXPERIMENTS: WATER-CEMENT RATIO IN CEMENT CONCRETE.

Interesting experiments as regards the influence of water cement ratio on the strength of cement concrete have been conducted in the Materials Testing Laboratory of the Engineering College, Bangalore. Results of some of these experiments are discussed in this article. The strength of cement concrete depends on many factors such as quality of cement, proportions of the mix, conditions of curing and water cement ratio. For a particular mix only one water cement ratio gives maximum strength. The experiments show that 6 gallons of water per cu. ft. of cement or a water cement ratio of ·67 gives the maximum compressive strength of 5,940 lbs. per sq. inch on a 4 inch cube of concrete of 1 : 2 : 4 proportions at the end of 7 weeks, the fineness modulus of the aggregates being 5. Even a small variation of water of 15 per cent. to 20 per cent. decreases the strength by nearly 50 per cent. The above water cement ratio gives a slump of ½″ to ¾″. A graph showing compressive strengths for different water cement ratios for the same types of specimen is given. Another set of curves shows compressive strengths of 1 : 2 : 3, 1 : 2 : 4, and 1 : 3 : 6 concrete specimens for different periods of setting. It is seen from these curves that the strength of cement concrete increases very rapidly during the first week and goes on increasing though at a smaller rate, up to 3 months and even up to six months in some cases.

THE CENTRAL BOARD OF IRRIGATION IN INDIA.

A review of the Annual Report of the Central Board of Irrigation, India, for 1935-36 is given herein. The extension of the Board's activities are referred to and research in irrigation carried out in Bombay, Punjab, the United Provinces and Sind is mentioned. The report under review is compared to the report for the previous year to show the progressive development of irrigation research. Irrigation research work is limited to only a few Provinces and it is urged that other Provinces such as Bengal and Madras should initiate irrigation research on the same lines as the few Provinces where such work is being carried out.

No. 9—March 1938.

Nothing of interest to irrigation engineers in this issue.

THE INDIAN AND EASTERN ENGINEER.

VOL. LXXXII.

No. 1—January 1938.

KING GEORGE VI BRIDGE OVER THE MEGHNA RIVER.

Important features of the construction of this railway bridge are briefly described followed by an account of the opening ceremony performed by Sir Guthrie Russell, Chief Commissioner of Railways. A special feature of this bridge is the manner of supporting the piers on foundation wells so as to ensure that the load is always equally distributed over the two wells on which the pier rests. This type of construction was considered necessary as a protection against earthquakes. The top of the wells have been finished off in the shape of cylindrical concave sockets, and on these two bearing surfaces rests the twin convex counterpart forming the base of the pier. The well tops and the pier base are heavily reinforced and there is a free bearing surface between the wells and the pier base, to ensure which the tops of the wells were treated with a special lubricating compound before the pier base was cast on them. A special machine was used to test every batch of concrete.

THE HUAI RIVER SCHEME.

A scheme for regulating the Huai River systems for flood control, navigation and irrigation is under construction in China. A few of the salient features of the scheme are described in this article. The main feature of the scheme is a regulator below Hungtze Lake through which the Huai river passes in its course to join the Yangtzekiang. This regulator consists of 60 sets of sluice gates each having a clear opening of 10 metres span, 5·5 metres deep, giving a total length of 745 metres between abutments. The regulator is designed for a discharge of 9000 M^3 per second (317,000 cusecs). Other works that are being constructed on some other river channels to deal with floods in the Yi Ho river valley and South Shantung Province are briefly described. The roller type sluice gates which are being installed by Messrs. Glenfield and Kennedy on all regulators comprising the scheme are described in detail.

UNDERGROUND WATER SUPPLIES.

This article describes the "Layne" system of well sinking developed by the International Water Company of New York. The special feature of this system is the use of a continuous stream of liquid clay which is pumped down through the boring tool. The clay emerges at the bottom of the drill and rises up the borehole bringing the debris around the advancing boring tool to the surface. The clay seal also forms an impermeable coating preventing the inflow of water from intermediate porous strata and also prevents caving in of the sides of the borehole. Steel tubes are then lowered to the required depth, the bottom tube having a closed end and 1 inch diameter holes drilled around the sides near the closed end. By means of a metal disc of slightly smaller diameter than the tube rapid hardening cement grout is forced down the tube under pressure and this emerges out of the holes in the bottom tube up to the surface encircling the tubes and forming a permanent cement seal. The closed end of the lowest tube is then drilled out and replaced by a strainer. Amongst the advantages claimed are softer and better quality of water, no further filtration, permanent sealing of the strata and the facility of working down boreholes.

THE VIZAGAPATAM-BEZAWADA THERMAL SCHEMES. Rajan.

The essential features of two schemes for generating cheap power with steam turbine plant at Vizagapatam and Bezawada in the Madras Presidency are described herein.

IRRIGATION ACHIEVEMENT, BIHAR'S RS. 5 CRORES' CROPS.

This is a review of a press note on the Son Canals of Bihar. (See page 112 of Quarterly Bulletin No. 8).

THE STUDENTS SECTION.

ENGINEERING ESTIMATES, CONTRACTS AND SPECIFICATIONS. Antia.

Specifications for handling and storage of explosives and of mortar and concrete are given.

PROJECTED WORK.

NIRA RIVER BRIDGE.

A proposal to join the irrigation tracts of the Nira Right Bank Canal and the Nira Left Bank Canal between Phalton and Sangvi by bridging the Nira River is under consideration. The design of the bridge, road and drainage works are now in hand. (See page 14 of Quarterly Bulletin No. 7).

HYDRO ELECTRIC STATIONS.

The West Kootenay Power Company in British Columbia intend to proceed with a new hydroelectric project to develop 100,000 horse power. This projected scheme will complete the development of Kootenay River power. Four dams and power houses on the river already develop 220,000 H. P.

FLOOD CONTROL IN MADRAS.

Next year's budget will include among other things an item for the construction of a dam costing about Rs. 1,00,000 to prevent the

Godavari River water from getting into the Torrige Dala River as a result of which an area covering 45 square miles is inundated every year.

ELECTRIFICATION IN BIHAR.

A draft scheme has been prepared by the Bihar Government for the supply of electrical energy for industrial and domestic purposes throughout the Provinces. It is proposed to install a chief generating station in the coal fields, and arrange for the transmission through a number of substations to various parts of the Province.

No. 2—February 1938.

ELECTRICAL PROGRESS IN MADRAS.

An account is given of the expansion of electricity in the Madras Presidency during the last few years as revealed in the administration report of the Madras Electricity Department for the year 1936-37 published recently. The total installed generating plant in service during the year in the whole Presidency amounted approximately to 98,500 kVA, and the total energy output was 136 million units. Expenditure on construction work handled by the department totalled nearly Rs. 72 lakhs. Among the more outstanding features of the year are the large additions to the Pykara Power Plant, substantial progress in the construction of the Mettur Hydroelectric Scheme, and the starting of work on the Vizagapatam and Bezawada Thermal Electric Schemes. The Pykara Hydroelectric Scheme was the first large power development scheme to be started by Government. It exhausted its full generating capacity in the fourth year of its operation, the revenue obtained being 60 per cent. in excess of that forecast for the tenth year. The increasing demand for power necessitated the construction of the Mettur Hydroelectric Scheme and further extensions to the Pykara Scheme. The extensions to the Pykara Scheme are described in brief. Investigations of the Papanasam Hydroelectric Scheme are complete and it is expected that the scheme will be sanctioned early in 1938. An experimental scheme for supplying irrigation water to small holdings of 200 acres from bore holes with the aid of electricity has been started in the Ceded Districts, and if the experiments are successful it is proposed to ask Government for permission to carry out similar experiments in other parts of the Presidency. The programme for works in the year 1938 is given in brief.

ELECTRICITY IN TRAVANCORE.

This is a short note describing the main features of the Pallivasal Hydroelectric project which is nearing completion in Travancore State. The present programme is for the development of 9,000 k. w. from the falls in Mudrapuzsha River. The total head available is 1,900 ft. which is distributed over a distance of 3 miles of the river course. The ultimate capacity of the project will be 22,500 k. w.

THE GERMAN MOTOR ROAD SYSTEM. Barry.

The new system of arterial motor roads which is under construction in Germany is developing into the greatest road system of its kind in the world. A Roads Delegation from England paid a short visit to Germany in September 1937 to see this new road construction. The author was a member of this Delegation and presents some notes on the new German motor roads in this article. The present scheme involves the construction of 4,500 miles of double tracked roads forming a net work over the whole country. Approximately 650 miles are being constructed each year. The normal cross section of a motor road provides for an overall width of 79 ft. consisting of two carriageways of 25 ft. each and a centre reservation of 10 to 16 ft. The greater length of roadway is of concrete slab construction. The expansion joints and system of curing employed are briefly described. A feature of these roads is the method by which other main roads are connected to them. This is accomplished by what is known as a "four-clover-leaf" form of junction. Another feature is that none of the motor roads pass through a city but are located some miles away from them. All types of bridges, reinforced concrete, steel, stone and wood are being constructed in conformity with local conditions. The average cost of these roads including bridges, etc., works out to £40,000 per mile approximately.

RUBBER ROAD CONSTRUCTION.

Some details of a new method of road construction with rubber materials are given in this article. The material is known as "Rubrmatic" and it is delivered on to the road in the same way as asphalt. After spreading it is raked and rolled. When cold, it is ready to receive traffic. It presents a rough mat-like non-skid rubber surface and can be laid at very nearly the same cost as asphalt.

THE STUDENTS SECTION.

ENGINEERING ESTIMATES, CONTRACTS AND SPECIFICATIONS.

Specifications for reinforced concrete, waterproof concrete and brickwork are given.

No. 3—March 1938.

AIR CONDITIONING APPARATUS, DESIGN AND PRACTICE. Fyyazuddin Ahmed.

Principles of designing air-conditioning apparatus with reference to the temperature, humidity, carbon-di-oxide content, etc., are discussed in this article.

THE SUKKUR BARRAGE.

An unofficial note on the Lloyd Barrage project is reviewed herein. (See page 113 of Quarterly Bulletin No. 8.)

METHODS OF TESTING CEMENTS FOR LARGE DAMS. Hellstrom.

At the Executive Meeting of the International Commission on Large Dams held in London in 1934, an International Sub-Committee on Special Cements was formed comprising representatives from various countries. The main objects of the sub-committee is to increase interest in cements suitable for use in mass concrete structures and to make suggestions as to routine methods for testing such cements. So far the main deliberations of the sub-committee have been concerned with investigations of routine methods to be used for testing special cements with reference to heat of hydration, action of water percolating through concrete on cement, shrinkage permeability and workability. An interim report was submitted by the Sub-committee to the Second Congress of the International Commission on Large Dams held in 1936 and this article is a short summary of the report. The recommendations of the sub-committee with regard to methods of testing heat of hydration, action of water percolating through concrete on the cement, shrinkage and permeability are set forth. With regard to testing workability the sub-committee state that no satisfactory or recognised method of testing workability of concrete has yet been evolved. Certain investigations have been carried out by the Swedish Committee on Large Dams on workability and these are given in an appendix to the report.

THE STUDENTS SECTION.

ENGINEERING ESTIMATES, CONTRACTS AND SPECIFICATIONS. Antia.

Specifications for brickwork, brick arches, brickwork in clay, reinforced brickwork, hollow walls, damp proof course, stone masonry, rubble masonry and block in course masonry are given.

THE INDIAN CONCRETE JOURNAL.

VOL. XII.

No. 1—January 1938.

EDITORIAL NOTES.

WATER AND CRUDE OIL-RESISTING CONCRETE COATINGS.

Some effective coatings for concrete tanks which are not attacked by water, fuel oil or gasoline are mentioned. A paste prepared from 24·2 parts of artificial varnish, 33·3 parts of hydrated lime and 42·4 parts of clay or other inert filler hardens in 7 to 8 days when spread in a thin layer. Another highly satisfactory coating consists of 7·8 parts of Portland cement, 59·4 parts of finely ground clay, 2 parts of sodium fluosilicate, and 37·4 parts of water glass.

LETTERS TO THE EDITOR.

Mr. F. L. D. Wooltorton in a letter to the editor draws attention to some aspects of the question of soil stabilization. He refers to a paper of his on the subject, published in the August 1937 issue of the *Structural Engineer* in which he mentions that engineers can obtain great help from soil specialists in other departments in the interpretation of some of the simplified tests. Simple cases are obvious - a sand road requires some cohesive binder such as clay and a clay road requires some fraction supplying material such as gravel. Various investigators have supplied data giving suitable proportions of the clay, silt and sand fractions for producing stable road surfaces. One of the standard methods to stabilize the moisture content is to use sodium chloride which acting on the soil carbonates produces sodium bicarbonate, causing by deflocculation of the clay fraction, a mass impervious to moisture movement. If the soil is alkaline, the addition of sodium chloride would be detrimental rather than beneficial. By base exchange the soil would become more sodiumized than before and instead of being stabilized is made more unstable by increased expansion and contaction and increased solubility. If it is proposed to use bitumen as a stabilizer to give cohesion or moisture stabilization, then the colloidal properties of the soil dust must be examined as to whether the electric charges are like or unlike those of the oil to be used. Unless the dust is capable of becoming the disperse phase to the oil, the result cannot be satisfactory.

DESIGN OF THE SAN JACINTO MEMORIAL. Cummins.

A memorial consisting of a concrete shaft 549 ft. high with a museum around its base is being constructed in San Jacinto, Texas, to commemorate the battle of San Jacinto. The design of this monument was complicated by the absence of any rock for supporting the foundations. Borings revealed a bed of stiff red clay from 6 ft. below surface to a depth of 100 ft. Tests for the bearing value of the soil showed a uniformly progressive settlement of the soil under standard plates 2 square ft. in area until the load reached 33,000 lbs. It was decided to limit the soil pressure to 8,000 lbs. per sq. ft. The footing for the shaft is 124 ft. square, and the base of the footing is 30 ft. below surface level. It consists of reinforced concrete, and calculations for the reinforcements are given. The shaft is octagonal in shape and is 47 ft. across at the base and 30 ft. across at the top. Computations show that under the windload of a wind velocity of 125 miles per hour there will be no tension in the concrete and hence vertical and horizontal reinforcements are provided for expansion and contraction stresses only. Calculations for thickness of the walls of the shaft which are 4 ft. thick are given. Other features of the structure are described with illustrations.

THE DEVELOPMENT OF SOIL MECHANICS. Wooltorton.

In this article the author discusses soil mechanics in relation to foundation engineering and suggests some lines of investigation which are likely to be of great practical value to the engineer. He also suggests that active co-operation between the soil engineer, the chemist, the physicist and the minerologist is essential for the full development of soil mechanics. Valuable lines of investigation have been suggested by a non-engineering study of the soil and some of these should be followed up in the interests of engineering. In the early days of soil mechanics it was thought that information could be gathered from mechanical and chemical analyses but now there is a growing feeling that much can be learnt from the soil physicist and soil chemist whose knowledge of soil behaviour and properties is of more practical use to the engineer. If two buildings of identical design on apparently the same soil show different effects in as much as one of them track and the other does not, the information given by a soil survey and the prescribed tests are not sufficient to account for the different behaviour of two similar soils and other considerations must be taken account of. Some of these are discussed and their effects are considered. These include the yearly variation in moisture content of the soil which causes shrinkage and swelling of the soil at different times. In a known case the yearly variation corresponds to a volume change of 10 per cent. which is capable of inflicting severe stresses on certain types of structures. Linear shrinkage, and the ratios of horizontal to vertical shrinkage for various soil types require further detailed investigation and therein may be found the explanation of sinusoidal curves of building deflection observed in various parts of the world. Other points which may profitably be investigated are the expansion pressure of various soils, the shrinkage limit of soils, the nature of clay complexes, and hygroscopicity of soils. These are discussed briefly in their relation to foundation problems. Investigations pertaining to these properties made by various authorities are referred to and further investigations which will be of great value to the foundation engineer are indicated.

CONCRETE 'FLOROFORM' FLOORS.

A special system of floor construction with precast reinforced concrete joists and floor filler blocks manufactured from lightweight aggregates is described in this article. The precast joists are placed across the span to be covered, 3 ft. apart centre to centre and the reinforced concrete blocks resting on the joists are placed in the space between two joists. The finished floor is then constructed on the top of the blocks.

DESIGN OF ARCH ROOFS. Terrington.

Continued from the issue of November 1937. The method of calculating normal thrust and shear at any section of a reinforced concrete roof arch is described and several examples are worked out for various conditions of loading and support. (See pages 30 and 31 of Bulletin No. 7.)

SIMPLE SAND TEST.

A simple method of determining the amount of free water and absorbed water in sand for a concrete mixture is described in this article. This method makes possible the correct estimation of the allowance to be made in the quantity of water to be added to a batch of concrete for variations in free moisture in the sand. The free moisture in the sand dilutes and weakens the mix and without an estimate of this free moisture scientific proportioning of the mix is not possible. In this method, a mould in the shape of an inverted cone with 1½ inch top and 2½ inches bottom diameters is filled with sand which is lightly tamped. Free moisture is indicated if sand holds shape after removal of the mould. If the sand slumps when the mould is removed, there is no free moisture.

ALVELEY BRIDGE. Mason.

The construction of a reinforced concrete girder bridge over the river Severn is described herein. The bridge consists of a river span of 150 ft. and two shore spans of 60 ft. The river piers are hollow structures bonded into mass concrete foundations which rest on blue clay. The shore abutments are designed as retaining walls to support the approach embankments. There are two parallel girders continuous over three spans and monolithic with the river piers, the extreme ends resting on sliding plates to provide for expansion and contraction. The girders are 9 ft. 4 inches apart and the deck slab is supported between them, cantilevering out on each side. The end spans were constructed by ordinary methods, the centering being supported on timber falsework. The centre span was constructed by cantilevering out consecutive sections from each end until the central gap was short enough to close in one operation. The work was done in 5 ft. sections, trollies on rails laid on the completed portion being used to support the cantilevered section. The construction operations are described in detail with illustrations. (See page 33 of Bulletin No. 7).

HEUGH STREET BRIDGE, SOUTH SHIELDS. Reid.

This article describes a reinforced concrete bowstring girder road-bridge of 164 ft. span over a railway track. The bowstring girders consist of a lower horizontal tie at deck level and a parabolic rib. The ends of the tie are connected to the ends of the parabolic top boom and vertical hangers suspended from the boom support the tie. The superstructure rests on four cast steel bearings of the rocker type which are placed on the abutments. The abutments are of reinforced concrete founded on strong brown clay. Features of design of the girder with the loads and superloads allowed for are mentioned, and specifications for the concrete mixes are given.

No. 2—February 1938.

MODERN ROAD PRACTICE : THE CONCRETE ROAD. Berry.

In this article notes on specifications, design and construction procedure of concrete roads are given. The author mentions the advantages of concrete roads and gives his recommendations with regard to drainage of the subsoil, preparation of subgrade, suitable thickness and camber under different conditions and the lay-out of bays in concreting. Steel forms are recommended in preference to timber forms, specifications of cement, ballast, sand, water and reinforcements for concrete road construction are given, and expansion joint construction with compositions of bitumen, cork, rubber, asbestos, etc., are discussed. Practical recommendations for mixing of concrete, deciding the correct quantity of water for the mix and placing of concrete are given and various methods of curing are described. The methods of constructing and filling in transverse joints are described and it is mentioned that existing methods of joint finishing leave a great deal to be desired and there is much room for experiment.

TOLLYGUNGE BRIDGE, CALCUTTA.

The main features of this bridge which is a reinforced concrete bowstring girder bridge of 110 ft. span carrying a 30 ft. wide roadway are described in this article. The abutments are of cement brickwork founded on reinforced concrete "Vibro" piles. The superstructure consists of two arch booms with horizontal girders which rest on rocker bearings on the top of the abutments. Vertical hangers support the girders and the arch booms are laced together with solid web portal bracings which provide great rigidity.

No. 3—March 1938.

This is a special road architecture number.

THE SYSTEM OF MOTOR ROADS IN GERMANY. Clements.

This is a description of the new system of motor roads known as the Autobahnen system which is under construction in Germany, by a member of the German Roads Delegation which made a tour of inspection of the new roads in Germany recently. Facts, figures and technical details are given of the various types of roads met with. In conclusion the author summarizes the impressions created by the inspection of this great undertaking.

EARTH ROADS.

This is a short article on the construction and maintenance of earth roads which will play an important part in rural uplift to which a great deal of prominence is being given these days. Tractors and graders are required for the construction of these roads, and maintainers are necessary for their subsequent maintenance. The maintainer is used to remove the ruts caused by bullock cart traffic. It removes high spots, fills in ruts and depressions, and generally irons out the road to its newly constructed state.

INDIAN ENGINEERING.

Supplement to December 1937 issue entitled " Made in India ".

This supplement contains a review of Indian industries and allied importations. A number of articles are included on India's Transport, Communication, Indian Railways, Indian Irrigation, the Iron and Steel Industry in India, Agriculture and Rural Welfare, Chemical Engineering in Industry, the Production and Use of Pipes, the Indian Sugar Industry, Electricity for Plantations, Asbestos Cement, Development of Tube Well Irrigation, Pumps and Tube Wells, Industrial Machinery, Constructional Engineering, General Engineering, Indian Timber Industry and Water Power in India.

The article on Indian Irrigation describes the Krishnaraj Sagar Dam and the Irwin Canal system taking off from the reservoir created by that dam. The article on Pipes describes various types of pipes with brief notes on their manufacture. The article on Electricity for Plantations described the various uses of electricity on the farm. The possibilities of windmills for pumping water and for driving electrical generators in conjunction with storage batteries are also discussed briefly. The State Tube Well Scheme in the U. P. is briefly discussed in the article on Development of Tube Well Irrigation. Various types of pumps are described in the article on Tube Well Pumps. The present status of water power development, the future possibilities, the economic and technical conditions relating to the supply of hydroelectric machinery and descriptions of some important hydroelectric schemes recently completed are some of the subjects included in the articles on Water Power Development.

VOL. CIII.

No. 1—January 1938.

KING GEORGE VI BRIDGE ACROSS THE MEGHNA.

This is a railway bridge across the river Mehgna which has recently been completed. It consists of seven steel girder spans of 330 ft.

each. Each pier is supported on twin wells, each twenty two feet in diameter sunk by the open dredging process. The deepest well is 147 ft. below water level. Main features of the work are described in brief.

NOTES AND COMMENTS.

SHIMSHA HYDRO-ELECTRIC PROJECT.

The construction of this project has been started by the Mysore Government. It will generate 23,000 H. P. and is estimated to cost Rs. 56 lakhs. The water will be picked up at Sivasamudram and conducted to the Shimsha power site by a channel 6 miles 1½ furlongs in length and having a capacity of 900 cusecs. Brief details of other accessory works are given.

AUTOMATIC SILT EXTRACTORS WITHOUT LOSS OF WATER.

Sharma.

The author describes the design of a new type of silt extractor evolved by him in which no water is lost during the process of extraction. Existing types of ejectors and extractors suffer from the drawback of the loss of a large quantity of water during their operation, but the water lost can be ill spared during certain periods of the year. The design described is for a distributary carrying 70 cusecs. The arrangement consists of a rectangular opening in the bed controlled by a horizontal automatic swing gate which opens under the load of silt and delivers the silt to a cistern below. The flow of this cistern has a cross slope of 1 : 20 which enables the silt to move out into the escape with the least quantity of water. The distributary channel is provided with cement plastered floor and sides for a distance upstream of the silt extracting aperture equal to 5 times the depth of the channel. This is necessary in order to concentrate the silt charge near the bed. The automatic device of the swing gate controlling the aperture and other accessories of the arrangement are described with illustrations.

INSTITUTION OF ENGINEERS (INDIA).

A brief report of the eighteenth annual session of the Institution held at Hyderabad Deccan from December 30, 1937 to January 3, 1938 is given.

No. 2—February 1937.

NOTES AND COMMENTS.

HAVELI PROJECT.

The foundations stone of the headworks of this irrigation project in the Punjab was laid recently by the Governor of the Punjab. The project will supply water for irrigation in Jhang, Muzaffargarh and Multan Districts. A special feature of the scheme is the proposed lining of the main canal for a length of 43 miles with a special type of lining of brick tiles and concrete. The scheme comprises five units namely Trimmu Headworks on the Chenab, Abdul Hakim Headworks on the Ravi, the left bank canals, the right bank canals and the Pakpattan Link canal. The first and the most costly unit is the barrage across the Chenab below its junction with the Jhelum, which is estimated to cost 2 crores of rupees. Canals will be constructed taking off from both banks of the river above this barrage. The right bank canal will serve a strip of *khadir* country and will be non-perennial. Two canals will take off from the left bank, one of which will be non-perennial and the other, the larger of the two, will transport the Chenab water into the Ravi river a few miles above the existing Sidhnai Headworks. The Sidhnai Headworks will be remodelled to deal with this additional supply. A number of inundation canals at present receiving a precarious supply from the Chenab will be linked up with the Sidhnai canals and will have a controlled supply of water. The winter supply in the Chenab at the site of the headworks will almost entirely be due to the regeneration water in the Chenab and Jhelum below the Khanki and Rasul Headworks. At present the Sidhnai canal gets its water from the Ravi but now that the water will be supplied to it from the Chenab, the Ravi water will be utilised for the Pakpattan perennial canals and extension of the Lower Chenab Canal.

INDIAN ROADS CONGRESS.

The Fourth Indian Road Congress was held in Hyderabad Deccan on January 4, 1938. Amongst the papers read were the following :

(1) A method of calculating the stability of braced pile piers.

(2) Franki Pipe foundations for road bridges.

(3) Reinforced concrete bridges of 24 ft. span constructed in Gwalior State.

(4) Reinforced concrete ridge across the Godavari River at Shahgadh in Hyderabad.

(5) Corrugations on road surfaces.

LETTERS TO THE EDITOR.

Mr. C. C. Inglis, Director, Central Irrigation and Hydrodynamic Research Station, Poona, comments on the article entitled " Considerations of slopes of flow in the design and maintenance of artificial channels " by Mr. R. K. Khanna published in the December 1937 issue of this journal. Mr. Inglis states that Mr. Khanna's statement that " very flat sloped channels " may be taken out from very steep sloped channels is true, provided the offtake can be located at a suitable point where the river is stable and this is a well recognized method of silt exclusion ; but such ideal head conditions are generally lacking. Mr. Khanna's idea that " in designing artificial channels we only need to provide for their silting up in their head reaches by means of free fall feeding or feeding through broad crested flumes " will not be taken seriously by anyone who understands the problem. The velocity formula developed by Mr. Khanna is merely a modification of Mr. Lacey's original and more accurate velocity formula which Mr. Khanna fails to acknowledge. As regards Mr. Khanna's statement that " there is no scientific basis for supposing that Kennedy's C. V. R. and Lacey's F. denote any relationship between the size of silt particles and silt transporting velocities of flowing water ", Mr. Ignlis points out that Mr. Khanna must be unaware of the recent research on the subject.

DRAINAGE WORKS ACROSS CANALS. Sharma.

Three proposed types of cross drainage works for drains with bed levels above the canal bed and flood levels lower than the canal supply level are described in this article. If the bed of a drain crossing a canal happens to be above the canal bed and its flood level below the canal supply level none of the usual cross drainage works namely aqueducts, level crossings or syphons are suitable. The author believes that such drains could be easily drawn into the canals and goes on to describe a type of suction weir whereby this could be effected. Model experiments were carried out by the author on numerous forms of this device for drawing a natural drain into a canal and the form of suction weir which was found to have the maximum efficiency is described, and the dimensions are given. The second type of work described by which the canal can be passed over the drain is essentially a low head spillway siphon. In this the drain passes undisturbed under the canal through the spillway structure over which the canal water flows. The third type is intended to pass the drain over the canal and consists of a venturi flume in the canal, the latter being syphoned through the flume underneath the drain.

INDIAN PATENT SPECIFICATIONS.

IMPROVEMENTS IN AND RELATING TO DAMS, WATER RESISTING WALLS AND THE LIKE. Specification No. 23420, November 16, 1936.

Parkinson.
Vint.
Gardner.

This invention relates to dams, reservoirs, etc., formed of concrete, ferro-concrete or other suitable materials and is particularly adaptable for a thin wall construction with a view to elimination of all difficulties inherent in thick construction, and ensures stability with increased margin of safety at much reduced constructional and maintenance costs. The reservoir or dam is constructed in the form of a wall of L. shaped vertical section made up of one or a series of units. The foot of the unit projects a suitable distance into the reservoir, the toe being turned down and connected to the cut-out or impervious strata which prevents water from seeping under the structure. The construction is such that the downward pressure of water upon the foot portion more than counter-balances the outward thrust on the breast portion of the wall. Rigid connections in the form of buttresses are provided between the vertical breast and the horizontal foot of the structure. A space is provided beneath the foot to which access may be had from the downstream side of the wall, which serves to drain away any seepage water and provides inspection facilities for the underside of the foot of the structure. When the wall is made up of a number of units, joints are provided between them. The advantageous features of this type of construction are discussed and similar forms of construction to suit other possible requirements are described.

IMPROVED APPARATUS FOR ASCERTAINING AND RECORDING THE DEPTH OF WATER IN A RIVER, AND FOR LIKE PURPOSES. Specification No. 24045, May 25, 1937.

This apparatus consists of an apertured member adapted to be submerged at the bottom of the river, reservoir, etc., a pipe leading from the aperture to the recording instrument at some remote location on the river bank, and means of anchoring the apertured member to the river bed in such a way that it is no obstruction to navigation, and is immune from damage by passing craft, rolling or floating debris etc. It is not affected by accumulation of silt around it or by scouring or erosion of the bed. The variations in the depth of water in the river operate the indicating instrument on the river bank through a pipe leading from the apparatus to the instrument. Details of this apparatus and anchoring arrangements, and the method of working are described.

No. 3—March 1938.

LETTERS TO THE EDITOR.

Mr. R. K. Khanna in reply to the comments of Mr. C. C. Inglis on his paper entitled " Consideration of silt in the design and maintenance of open earthen channels " says that his velocity formula for earthen channels is applicable to flow in earthen channels under all the infinitely varying conditions and he fails to see what possible connection his formula can have to Mr. Lacey's Regime Test formula which is obviously applicable to channels in regime only. He refers to his book " Theory of flow of water and hydraulics of rivers and canals " wherein the actual method of derivation of his formula is given.

OUR LONDON LETTER.

NOVEL PILE DRIVING METHOD.

An interesting system of piling known as the Rotinoff system has recently been devised. In this system the beginning of the pile is a concrete shoe upon which rests a steel mandril. Round this mandril are threaded precast concrete tubular sections or shells each 3 ft. long. The blows of the hammer are transmitted directly to the shoe *via* the mandril. At the same time through a special patented arrangement on the mandril, sufficient force is applied to the concrete sections to overcome the skin friction and drive them into the ground at the same rate as the shoe. After the necessary set has been obtained the mandril is withdrawn and a hole is left in the ground which is perfectly protected by rigid concrete shells and which can be inspected from top to bottom before the reinforced concrete core is inserted. Since the brunt of the driving is taken by the mandril, core reinforcements need be very light.

INDIAN PATENT SPECIFICATIONS.

IMPROVEMENTS RELATING TO AIR CONDITIONING AND VENTILATION.

This invention relates to air conditioning and ventilating units suitable for use in offices, hospital rooms, school rooms, hotel rooms and residences. Details of the device are described.

THE EFFICIENCY OF CENTRIFUGAL PUMPS.

Research work for improving the efficiency of centrifugal pumps is described and the application of the results to the manufacture of pumps with increased efficiencies are exemplified.

DETERMINATION OF CAPACITY OF A SIPHON AND OF COEFFICIENT DISCHARGE WHEN IN FULL BORE FLOW.

The alterations carried out to improve the discharging capacity of a siphon in a certain canal in the Punjab and the method adopted for the subsequent determination of the capacity of the siphon are described in this article. A breach having occurred above the siphon when the water level was at the maximum for which the siphon was designed, there arose some doubt about the full capacity of the siphon. The investigations made in this connection which resulted in certain alterations being carried out at the downstream end of the work, are discussed. A method was developed for determining the capacity after the alterations were carried out, and the procedure is described.

THE INDIAN FORESTER.

VOL. LXII.

No. 7—July 1936.

EFFECT OF FORESTS ON EROSION, FLOODS, CLIMATE AND RAINFALL, AND ON IRRIGATION EXPERIMENTS. Warren.

This is the summary of a lecture delivered at the Science College, Patna University. The evil effects of denudation are explained and it is stated that on account of denudation of the Chhota Nagpur area the climate had changed to such an extent that it was no longer possible to extend tea plantations. Erosion as a result of denudation is discussed. The beneficial effects of contour irrigation with small masonry bundhs at stream crossings constructed on the hill sides to arrest the run-off of water and utilizing it for irrigation of hill slopes are explained, and an example of an actual operation of this nature carried out recently is given.

VOL. LXIII.

No. 4—April 1937.

EROSION SURVEY OF THE UHL VALLEY. Gorrie.

In the summer of 1936 a detailed survey of erosion conditions in the catchment area of the Uhl River was undertaken at the request of the Chief Engineer, Electricity, Punjab, as some anxiety has been felt for the safety of the Uhl River Hydroelectric Project owing to the occurrence of uncontrollable floods in the summer and a very poor free water flow in the winter. A brief outline of the methods employed is given in this article.

THE INDIAN JOURNAL OF AGRICULTURAL SCIENCE.

VOL. VII.

Part VI—December 1937.

EFFECT OF FARMYARD MANURE ON FIBRE-CHARACTERS OF COTTON. Nayak.

In this paper results are described of a study of the fibre characteristics of cotton raised in plots receiving varying quantities of farmyard manure at the Government Experimental Farm, Dharwar. The conclusion is that there is not much variation in fibre characteristics with the variation in quantities of farmyard manure. It cannot be said that larger quantities of farmyard manure induce superior qualities.

VOL. VIII.

Part I—February 1938.

INHERITANCE OF EARLINESS IN UNITED PROVINCES RICES, II.
Sethi.
Sethi.
Mehta.

This paper deals with the results of a study of earliness or duration from sowing to ripening made with certain new varieties of rice known as *Sathi* crosses which are immune from the attack of the *gundhi* fly. These crosses were evolved from a combination of the early growing *sathi* type which are coarse grained and unaffected by *gundhi* fly and some finer grained types of rice with a view to obtain a type possessing the desirable qualities of both types. The object of the studies described herein was to ascertain how far the new type inherited the early ripening properties of the original *sathi* type.

INDIAN ROADS.

No. XII—November 1937.

THE THEORY OF SOIL CONSOLIDATION AND TESTING OF FOUNDATION SOILS BY THE DIVISION OF TESTS, BUREAU OF PUBLIC ROADS (U. S. A.). Palmer. Barber.

This article describes an apparatus and testing procedure for determining the consolidation characteristics of soils in the laboratory, designed by Dr. Terzaghi. A practical method is presented of estimating that part of the total settlement of soil caused by the loss of water forced vertically out of saturated compressible strata in certain soil profiles. The theory of consolidation of earth materials is discussed. The most essential steps in some of the mathematical derivations used for the computation of earth pressures and for computation of formulas applicable to the consolidation of relatively impervious saturated strata caused by these pressures are introduced. Computations are given for various types of pressure distribution and boundary conditions. Some examples are given with their solutions to illustrate the application of the theory of soil consolidation to problems of pressure distribution.

CONCRETE PILE DRIVING. McCarthy.

Essentials of concrete pile driving are discussed in this article.

THE MECHANICS OF THE VOUSSOIR ARCH. Pippard. Tranter. Chitty.

This paper describes the results obtained from experiments carried out with a model of a voussoir arch in the Civil Engineering Department of the Imperial College of Science and Technology. The experiments were concerned with the behaviour of a voussoir arch under load under varying conditions of end supports.

VIBRATION FOR CONCRETE ROAD CONSTRUCTION.

A vibrating apparatus for concrete roads is described herein.

ROAD RESEARCH.

This is a review of the report of the Road Research Board for the year ended 31st March 1936. The important researches carried out are briefly described. Experimental research on sub-soils shows that the mechanical behaviour of soils fundamentally depends on compressibility, permeability, resistance to lateral movement, and elasticity, and these properties in their turn depend on the structure and moisture content of the soil. By means of tests described in the report the suitability of soils for fill construction may be found. Other investigations described include researches on the properties of aggregates and their mixtures with binders. A table is given in the report showing the water cement ratio required to produce concrete of low, medium and high workability for different aggregate grading. Experiments made in the laboratory and the field with the aggregate vibrator have shown that greater uniformity in the strength and quality of concrete results from the vibration of sand and gravel saturated with water.

EXTRACTS.

Abstracts of literature on road engineering published in various countries are given. Some of these are mentioned below.

1. The use of wood and wood chips for road making.
2. Composite timber decks for highway bridges.
3. Landslips in south-eastern France: Serious landslips which occurred recently are attributed to the softening action of waters charged with calcium sulphate on strata of morainic clay. Features of the slips are discussed and remedies are suggested.
4. Provisional instructions for carrying out construction work on the National Motor Roads (Germany). Preliminary soil tests and construction of earthworks.
5. The application of geophysical methods to grading and other highway construction problems.
6. Stabilizing soil with Portland cement.
7. Vacuum concrete.
8. Treatment of roads with sodium silicate.
9. Expansion joint fillers.
10. The use of bamboo for reinforcing concrete for road making.

POONA AGRICULTURAL COLLEGE MAGAZINE.

Vol. XXVIII.

No. 3—December 1936.

Importance of Chemical Analysis of Well Waters for Irrigation of Crops in Agriculture. Amin.

This article describes the results of investigations undertaken with a view to study the cause of soils becoming impermeable by irrigation with certain well waters known as *chopada* in Gujarat. The waters of a number of wells were analyzed and it is shown that the impermeability of soils is caused by soda-bi-carb present in large quantities, and magnesium and calcium bi-carbonates in small quantities. Other features of well waters are discussed in relation to their suitability for irrigation.

SCIENCE AND CULTURE.

Vol. 3.

No. 7—January 1938.

General Presidential Address, Indian Science Congress, January 1938.

This is the presidential address delivered by Sir James Jeans at the Jubilee Session of the Congress. After a short introductory address, Sir James Jeans read the address prepared by Lord Rutherford the President elect of the Congress before his sudden death. Lord Rutherford refers briefly to research in buildings and roads carried out in Great Britain and stresses the necessity of similar research organizations in India and indicates the lines on which this should be planned.

Letters to the Editor.

A Note on the Experiment to Investigate into the Effect of Dusting Paddy Plants with Paris Green Powder on the Yield of Grain and Straw. Hedayetullah. Roy.

The campaign of dusting paddy fields with Paris green powder as a larvicide against mosquitoes has been undertaken by the Railway administration in India in connection with anti-malarial work. It is reported that the dusting is successful as a larvicide but the campaign has been objected to by the cultivators on the ground that the treatment affects the yield of paddy adversely. Experiments were conducted at the request of the B. N. Railway authorities at the Dacca field experiment farms and these are described in this note with their results. The following conclusions were arrived at from the experiments.

1. The reduction in yield of grain due to dusting with Paris green was about 20 per cent.
2. The deleterious effect is positive and is independent of the time of dusting with respect to the various stages of growth of the plant.
3. There is practically no effect of dusting with 20 p. c. Paris green on straw.

Further experiments are contemplated with some other larvicides.

RESEARCH INSTITUTES.

Brief accounts of Government Research Institutes of India are given. These include the Imperial Council of Agricultural Research and the Forest Research Institute. Details of the development and activities of these institutes are given in brief.

No. 8—February 1938.

NEED FOR A POWER RESEARCH AND INVESTIGATION BOARD IN INDIA.

In this article the editor reviews the presidential address of Dr. M. N. Saha to the National Institute of Sciences of India wherein the necessity of large scale industrialization of the country as a solution to India's problems of poverty, ignorance and disease is emphasized. Speaking of the power resources of India Dr. Saha says that not only are the power resources undeveloped but the power available is extremely expensive in as much as its cost is 12 p. c. of the manufacturing charges as compared to 3 p. c. in European countries. The phenomenal growth of Russian industry is quoted as an example, and the plans adopted by the Russian Govt. to achieve this industrial success are mentioned. With regard to electrical power production in India Dr. Saha says that power in almost all parts of India can be obtained from the energy of flowing water. But as hydroelectric schemes are expensive, preliminary studies must be made, which would include a summary of water power resources showing the variation of discharge of rivers, possibility of erecting storage reservoirs, selecting best sites, and an economic survey with a view to utilize all the power produced. Laboratory experiments should be carried out with models of the proposed works. The Mandi Hydroelectric scheme and the Western Ganges Hydroelectric scheme are criticized as holding the world's record for expense and this is attributed to insufficient preliminary investigations. In the Mandi scheme nearly 6 crores of rupees are said to have been wasted before it was discovered that the river from which power was to be obtained ran almost dry in the hot season.

BIHAR ELECTRIFICATION SCHEME. Ray.

In this article the author sets forth a proposed scheme for electrification of the Province of Bihar by generating electricity from certain falls and by steam generating stations located at certain important centres in the province. Bihar is far behind other provinces in electrical generation though it is the source of a large portion of the coal supply of India. Ample water power is available in the Southern part of the province and it will be profitable to harness this energy inspite of proximity to coal fields. The location of falls which are probable sources of power are described and their suitability for hydroelectric generation are discussed. The province may be divided into four important zones, in three of which steam generation of electricity is suggested. In the fourth zone comprising the Chhotanagpur Hills, two falls are mentioned which may be harnessed for hydroelectric generation. In north and central Bihar irrigation pumping will form the major portion of the load. There is an industrial area in south central Bihar where coal, iron and steel industries will supply the load, as also some other minor industries such as oil mills, chemical industries and cement factories. The various power generating centres may ultimately be linked up to form a grid over the whole province which has great possibilities in the future. A rough estimate of this scheme based on Rs. 600 per k. w. hydroelectric and Rs. 220 per k. w. steam generation has been worked out and amounts to about 10 crores of rupees.

SCIENCE IN INDUSTRY.

The Government of India have lent the services of the Timber Development and Wood Preservation Officer, Forest Research Institute, Dehra Dun to the Travancore Govt. where he will carry out investigations into the forest resources of the State and the possibilities of replacing iron and steel by timber for engineering and building construction. The replacement of steel by timber has been made in Japan, Scandinavia and other countries and has resulted in great economy without detriment to efficiency and safety.

No. 9—March 1938.

SCIENCE IN INDUSTRY.

UTILIZATION OF MOLASSES AS ROAD-MAKING MATERIAL.

The Imperial Institute of Sugar Technology at Cawnpore have been engaged for some time in experiments for converting molasses into an insoluble resinous product for use as road surfacing material. *The Indian Trade Journal* publishes an account of the process which is briefly described herein. The process consists of resinification of molasses with a mixture of coal tar and asphalt in the presence of acids. Details of the process and of the method of application of the product for road building with costs, are given.

THE ENGINEERING JOURNAL (CANADA).

VOL. XX.

No. 6—June 1937.

Semicentennial Number.

IRRIGATION ENGINEERING.

This is a résumé of fifty years of irrigation in Canada. A history of the development of irrigation with brief references to irrigation works and agencies during the last fifty years is given.

CIVIL ENGINEERING (NEW YORK).

VOL. 7.

No. 12—December 1937.

This issue of Civil Engineering is devoted mainly to general summaries of the papers presented at the meeting of the American Society of Civil Engineers held in Boston in October 1937.

LET THE ENGINEER DO HIS JOB. Compton.

The question of the relations of the engineer to the Government in respect of the analysis and administration of important public works projects is discussed in this article. If the engineer's expert advice is neglected in a public enterprise the nation is likely to suffer. For better administration it is necessary to effect improvement in the technical quality of engineering services employed, in the integrity of the engineers who are connected with Government work so that with the powerful backing of the engineering profession they may be able to oppose undue political pressure, and in a clearer distinction being made between political and social considerations on the one hand and engineering efficiency on the other. If the public is clearly and accurately informed of the conditions pertaining to a project, the government can protect itself from future criticism and the public is protected from improper exploitation. The Passamaquoddy Tidal Power Project is quoted as an example where failure to act on the above principles on the part of Government resulted in waste of public money.

ASPECTS OF PUBLIC-WORKS CONSTRUCTION.

Criticial reviews of public works projects in the hydraulic field were presented in four papers. These papers are briefly summarized.

HAZARDS OF UNECONOMIC PUBLIC WORKS. Riggs.

This is the first of the four papers mentioned above in which the economic justification of certain large projects which have been taken up by the United States Government as relief undertakings is questioned by the author. These include the Passamaquoddy Tidal Power Scheme, the Missouri River Project of which Fort Peck Dam now under construction is the main feature, and the Columbia Basin Project which includes the Bonneville and Grand Coulee Dams.

THE FLORIDA SHIP CANAL AND OTHER PROJECTS. Wilgus.

In this article the author emphasizes the need of judging the merits and demerits of public works projects from the economic angle. The Florida Ship Canal is reviewed and its utter lack of economic justification is shown. In the author's opinion the money saved from such uneconomic enterprises may be more usefully devoted to the construction of additional public thoroughfares for growing automobile traffic, thereby serving a greater need.

ENGINEERING-ECONOMICS AND PUBLIC OPINION. Mead.

The author says that many ill conceived and unwarranted public and semi-public works have been undertaken by the Federal administration since the beginning of the depression. The record of government in the field of industry is unsatisfactory and warrants no further extension. The further entrance of Govt. into the hydroelectric power field is an immediate danger. Hundreds of millions of dollars have been wasted on navigation projects of no economic value, such as the Fort Peck Dam. The unified development of the Tennessee River for power, flood control, and navigation by the TVA is attacked by the author and it is shown that the scheme is uneconomic. He considers the Grand Coulee project to be absurd on economic grounds because there is no market for power and no demand for irrigation for years to come.

ECONOMIC ADVANTAGES OF ORDERLY PLANNING. Fay.

The economic advantages of orderly planning in public works construction are outlined in this paper.

THE SCIENTIFIC METHOD IN EARTHWORK. Gilboy.

In this article Dr. Gilboy reviews the contribution of soil mechanics to the design of spread foundations, pile foundations, retaining walls, and earth dams. Modern soil mechanics has brought the application of scientific methods to earthwork engineering in place of the old rule of thumb methods. In the case of spread foundations, the concept of a bearing value depending only on the soil type had been the main consideration in design in the past. Today the well informed foundation engineer takes into consideration not only the soil type but also such factors as the size and depths of foundation elements the nature and use of the structure, the allowable settlement and the effect of time. He has also many more tools at his disposal including better methods of exploration and testing. In the case of pile foundations, old ideas have undergone a radical change. The old formula for the bearing value of piles which was good enough in the days when pile driving operations consisted of driving wooden piles with a drop hammer is no longer adequate with the wide variety of piles and driving equipment used today. The idea that the behaviour of an individual pile will indicate that of a group is recognized to be obsolete and untenable. Few complications arise in the case of pile foundations in cohesionless soils ; but if clay is present extreme caution is necessary because driving formulas and individual loading tests cannot be relied upon. The manner in which piles transmit their loads to the soil is still a very uncertain feature.

In the case of retaining walls Rankine's theory had held the field, and although originally the theory related to cohesionless soils, it was applied to cohesive soils as well. Scientific investigation has shown that the intensity and distribution of pressure on a retaining wall vary considerably with the nature and amount of the deformation of wall and backfill and cannot be depended upon to correspond even approximately to the Rankine values except under very special conditions. Two examples are given to illustrate that even with sand traditional methods of estimating earth pressure do not give a correct and complete picture. One refers to a deep cut in sand where the restraining elements were horizontal boards fixed between the flanges of H beams driven vertically with braces across the cut between the tops of opposite beams. As excavation proceeded boards were added successively working downward. The bracings began to buckle as loads considerably greater than had been allowed for were thrown on the upper part of the retaining walls. The other case is that of a steel sheet pile cofferdam sunk in a sand deposit for the construction of a pier.

Studies of seepage through and under earth dams have removed many misconceptions. It was generally believed that in a homogeneous embankment on an impervious base the position of line of saturation depended on the permeability ; the tighter the dam, the steeper the drop. Actually the flow pattern is a function only of the geometrical properties of the section and is independent of the permeability. Many engineers thought that the way to keep the saturation line within the body of the dam was to flatten the downstream slope. In reality the saturation line will always come out on the slope and in order to keep it within the dam it is necessary to make the section non-homogeneous and introduce a drain of greater permeability in the neighbourhood of the downstream toe. There is now a growing tendency to recognize that it is not necessary to make all dams water-tight. The emphasis has shifted from the problem of stopping leakage to that of controlling it by leading it out of the dam through carefully prepared channels. The importance of collecting field data on dams during construction and after completion is emphasized. Important advances have been made in the design of embankments on plastic and compressible foundations. An interesting corollary somewhat at variance with previous notions is that the attainment of maximum possible compaction in an embankment is not always desirable, too much compaction producing excessive swelling stresses.

THE OUTARDES HYDROELECTRIC PROJECT. Acres.

Principal features of the design of a hydroelectric project on the Outardes River to supply power to a newsprint concern. The falls that provide the head comprise a reach of the river about a mile in length in which the drop is about 190 ft. The works consist of a concrete dam and intake on the Outardes River from which a wood-stave pipe line extends 5,960 ft. after which it connects with a steel pipe line 450 ft. long terminating at the surge tank. The wood-stave pipe is 17 ft. 6 inches in diameter the largest of the type ever built. The steel pipe is 18 ft. in diameter. Two steel penstock pipes take the water from the surge tank to the power house which is equipped with two vertical shaft turbines each rated at 35,300 H.P. One of the turbines will serve as a standby. The transmission line is 13½ miles long.

BASIC FORMULAS FOR COMBINED FLEXURE AND DIRECT STRESS. Witmer.

Some general formulas for problems involving combined flexure and direct stress are discussed in this article. They obviate the further application of the principles of differential equations which arise in the solution of such problems.

COMPUTING MAXIMUM MOMENTS FROM MOVING LOADS. Popper.

The maximum moment at any given point on a span produced by a standard system of concentrated moving loads can be determined quickly and accurately by the method described in this article.

A HANDY SLIDE-RULE SHORTCUT. Davidson.

A method is described of obtaining the square root of the sum or difference of two squares on a slide rule.

CURRENT PERIODICAL LITERATURE.

DAMS.

Concrete Gravity. Raising of O'Shaughnessy Dam 85 ft. *Western Construction News*, December 1936. This article describes the raising of San Francisco's Water Supply Dam from 345 ft. to 430 ft. above foundation. Design problems and construction procedure are reviewed, including artificial cooling of added concrete, aggregate preparation, and abutments.

FOUNDATIONS.

Stability of earth slopes. *Boston Society of Civil Engineers Journal* July 1937. Contains the following: Comparative review of methods proposed for analysis of stability of earth slopes; simplifying assumptions; measurement of constants describing shearing strength of soil; effect of seeping water; effect of saturation and seepage; surface cracking; illustrative examples.

EQUIPMENT, MATERIALS, AND METHODS.

VERTICAL CENTRIFUGAL PUMP FOR DEEP OR SHALLOW WELLS.

A new vertical close coupled motor driven centrifugal pump for general service in deep or shallow wells has recently been announced. This new pump meets the need for a small compact pump with low initial and operating costs for pumping water under high or low pressure at 6 to 60 gallons per minute. They are suitable for lifts up to 200 ft. deep.

VOL. 8.

No. 1—January 1938.

A FOUNDATION PRIMER. Feld.

A rational basis of the treatment of foundations of small buildings is presented in this paper. Different classes of foundation soils are discussed and limitations and peculiarities of each are pointed out, and practical suggestions are made for dealing with them. Behaviour of sand under loading, precautions to be taken with foundations on clay, and the causes of settlement of structures are amongst the subjects dealt with.

THE WORK OF THE U. S. LAKE SURVEY. Pettis.

The primary function of the U. S. Lake Survey is making charts of the Great Lakes for the convenience of navigation on the Lakes. Triangulation, soundings, discharge measurements, precise levelling and topographic work are all a part of the routine field operations. The Lake Survey problems and achievements since its creation in 1841 are described herein.

ENGINEERING PIONEERING SINCE JOHN SMEATON. Kirby.

John Smeaton the builder of Eddystone Lighthouse was the first man to subscribe himself a civil engineer. He carried out a number of important investigations in hydrostatics and the hydraulic properties of lime. In this article leading developments in the field of civil engineering since his time from 1750 to 1900 are reviewed.

FORMULA FOR PASSIVE EARTH PRESSURE. Andersen.

A formula for passive earth pressure is discussed in this article. Passive earth pressure is defined as the opposition of cohesionless soil to lateral displacements of a vertical frictionless wall. The formula is useful in analyzing stresses in sheet piling driven into sloping banks.

BOOK REVIEWS.

Prof. Shoklitsch's monumental work *Wasserbau* has been translated into English by Samuel Shulits and published by the American Society of Mechanical Engineers under the title of *Hydraulic Structures.* The work is in two volumes and covers hydrology, general hydraulics, dams, materials of construction, hydraulic machinery, water supply and irrigation works, soil mechanics, sewers and sewage disposal, hydroelectric power plants. river improvement and flood control and inland waterways.

No. 2—February 1938.

THE MANUFACTURE OF ASPHALT. Abson.

Asphalt is one of the world's oldest and most useful materials of construction. Amongst its earliest applications was its use for water-proofing and for preservation against the elements, as for example in the encasement of mummies in Egypt. The development of the processes of manufacture and the production processes and physical characteristics of principal commercial forms are described in this article.

MACHINES AND METHODS FOR CANAL CONSTRUCTION, COLORADO RIVER AQUEDUCT. Chadwick. Archibald.

The Colorado River Aqueduct is being built to carry a flow of 1,605 cu. ft. of Colorado River water to Los Angeles and twelve other cities in California. It consists of 62·8 miles of open canal, 54·5 miles of cut and cover conduit, 28·7 miles of siphons and 92 miles of lined tunnel. The open canal section is concrete lined and has a bed width of 20 ft., side slopes of 1 : 1½, and a depth of 11·7 ft. This article deals with the construction of the open canal with special reference to the machines used for preparing the subgrades and placing concrete. The excavation for the canal was done by draglines. A special subgrade trimming machine was developed and is described. Concrete lining of the canal was placed monolithically by means of a large special lining machine developed by C. W. Wood. It consisted of a stee form plate fastened to the underside of a trussed frame an provided with feed hoppers and a motorized distributor car. The machine was drawn by power winches. The machine moved forward continuously, shaping the base and sides of the canal as it passed. Vibrators were used in this machine for vibrating the lining concrete. The rate of progress of the machine was about 1 ft. per minute. The final finishing was done by hand by men standing on runways suspended at the back of the machine. Two coats of sealing compound were applied to the surface of the finished concrete by a pneumatic sprayer. The approximate cost of the lining is $153,000 per mile.

SOIL CONSERVATION IN THE TEXAS BLACKLANDS. Hill.

Enormous tolls are taken from farm lands each year by water and wind erosion, and the effects are reflected in soil depreciation and reservoir silting. The work of the soil conservation service in the Elm Creek Watershed of Central Texas has shown that such losses and their effects are largely preventable. Among the methods found most effective are terracing, strip cropping, pasture furrowing, gully control by check dams, and encouragment of vegetation cover. These methods are briefly described and their beneficial effects are explained.

APPRAISAL OF UNIT-GRAPH METHOD OF FLOOD ESTIMATION. Pettis.

A unit-graph is a hydrograph of a single flood on a particular river with the discharge plotted as ordinates to a horizontal scale that represents time intervals. In this article the author gives a critical analysis of the method with a view to determining its accuracy, advantages and limitations in its application to the determination of certain facts concerning the flood characteristics of rivers. The conclusions are given.

VARIABLE MULTIPLE-WEIR CANAL DROP. Buzzell.
Lebsack.

In designing the supply canal and power plants for the Central Nebraska Public Power and Irrigation District, it was found necessary to provide drops into two of the regulating reservoirs which would safely handle a flow of 1,800 to 2,000 cu. ft. per second throughout a large range of tailwater levels. The ordinary chute type of drop with a stilling basin at its terminus such as is used for canal drops was considered unsuitable. Model experiments were carried out by the authors with several types of drops and ultimately a sloping chute with a number of weirs across it curved in the form of a parabola was found to be the most satisfactory in handling the required quantity of water without excessive turbulent action.

SOLVING QUADRATICS BY SLIDE RULE. Barnett.

A method is given of solving a quadratic equation by the slide rule.

OUR READERS SAY.

IMPORTANCE OF STUDY OF FLOW ON STEEP SLOPES. Nelidov.

This is a comment on an article entitled " Flow on steep slopes " in the September 1937 issue of this journal.

SHORTCUTS IN USE OF SLIDE RULE. Curtis.

This is a comment in amplification of the method described in the article entitled " A Handy slide rule shortcut " which appeared in the December issue of this journal.

CURRENT PERIODICAL LITERATURE.

DAMS.

Concrete Arch Dam. Ruby Dam of Skagit River Project. *Western Constr. News June 1937.* Features of the dam and use of model tests in its design are described.

Stilling Basins. New type of energy diffuser for hydraulic structures. *Western Constr. News June 1937.* Design of velocity reducer for spillway structures featuring bucket extended to horizontal position to produce roller action.

FLOOD CONTROL.

Engineering and design for Los Angeles flood control. *Military Engineer, July-Aug. 1937.* Surveys and hydrologic studies; hydraulic design, structural design, description of laboratory.

COLORADO SCHOOL OF MINES QUARTERLY.

VOL. XXXII.

No. 1—January 1937.

" Geophysical Studies 1932—1936 ".

THE APPLICATION OF ELECTRICAL RESISTIVITY PROSPECTING TO GROUNDWATER PROBLEMS. Tattam.

The Gish Rooney method of measuring electrical resistivity in geophysical water surveys for the purpose of determining the presence, depth and salinity of water is discussed in this article. The author has worked out a method of ground water depth calculations from resistivity measurements by the electrical method which he explains numerically and graphically. The geological conditions under which satisfactory results are obtained with this method are discussed. Indications as to the degree of salinity are much more difficult to obtain and interpret by this method while depths to water may generally be calculated with a fair degree of accuracy.

CURRENT FARM ECONOMICS, OKLAHOMA.

VOL. 10.

No. 2—April 1937.

No. 3—June 1937.

No. 4—August 1937.

These bimonthly circulars contain information on the agricultural and economic situation in Oklahoma, yields of crops, index of prices and other matters mostly of local interest.

ENGINEERING NEWS-RECORD.

VOL. 119.

No. 23—December 2, 1937.

NEWS OF THE WEEK.

A report prepared by the New York State Power Authority and transmitted to the Congress by President Roosevelt, discusses the question of relative economy of steam and hydroelectric plants for electrical generation and comes to the conclusion that Federal hydroelectric schemes are definitely cheaper than steam plants.

COMMENT AND DISCUSSION.

In the issue of September 23 of the Engineering News-Record the following problem was offered for solution : " A beam with fixed ends, having a clear span of 40 inches is subjected to a load of 500 lbs. placed at the centre. The beam is 2 inches wide and ½ inch deep. Which type of beam, cast iron or steel, will deflect most under these conditions ? " A number of solutions of this problem have been given indicating that a cast iron beam will deflect more than a steel beam.

ALGERIAN DAMS OF PLACED ROCKFILL. Gutmann.

Rockfill dams included in the current programme of the French Government for irrigation development in Algeria indicate a trend toward standardization on new lines. The practice of loose dumped rockfill has been abandoned. The fill of all the new dams has been carefully placed by machine and by hand, and they are provided with heavy cut-off walls carrying inspection galleries in their entire length. Deep grout curtains are provided upstream of the cut-off walls. The upstream slope is faced with concrete or asphalt paving. The downstream faces have a slope of 4 to 5 and a liberal free board, of 13 ft. or more is provided. The rockfill and impervious deck construction of the upstream face of four dams are described in this article. Principal features of the four dams are first described in brief. The dams have crest lengths of 722 ft., 820 ft., 886 ft. and 1,510 ft. and heights of 146 ft., 92 ft., 233 ft. and 180 ft. respectively. Two of them are provided with reinforced concrete decking, while the other two have bituminous concrete decking of a flexible type owing to uncertain foundation conditions.

The rockfill of all the four dams is virtually cyclopean rubble masonry carried up in horizontal layers. Foundations are described in brief and in general the sites indicated a complex geological structure consisting of every variety of unfavourable sub-surface material. The sections of the dams are plain trapezoids. The reinforced concrete decking of the upstream face of the Bakhadda Dam is described in some detail. This decking is of two course construction, the base slab being 12 in. thick and the top slab 16 in. thick. The surface of the rockfill was first coated with a thin layer of gunite and painted with a double coat of coal tar. Over this the reinforced concrete base slab 12 in. thick was constructed. The reservoir was then kept filled for seven months to test the slab and effects of settlement. After this test, the reservoir was drained, the surface of the base slab was cleaned and painted with several coats of coal tar and the top slab of the concrete deck was constructed. This was 16 inches thick and was heavily reinforced. The joints consisted of V shaped copper strips fixed to the concrete with bronze bolts and screws. The bituminous concrete deck construction on the upstream face of the Ghrib Dam is also described in detail. The upstream face is first covered with a layer of special porous concrete 3 in. thick. Over this are applied two layers of bituminous concrete each 2⅝ in. thick and this is finally covered with another layer of porous concrete 4 inches thick. The composition of the bituminous concrete used is given and the equipment used in placing it is described with illustrations.

The catchment areas, discharges and spillway provisions in the four dams are briefly described and it is mentioned that hydraulic model tests were carried out in deciding the final design of spillway structures.

LONG CULVERT BUILT BY JACKING. Scotzin.

Describes working procedure and equipment used in jacking a 3 ft. diameter pipe culvert 210 ft. through a 66 ft. fill. The work was carried out to replace a 36 inch drainage pipe culvert through a 66 ft. deep road embankment in Pennsylvania which had collapsed just after it was erected. The jacking operations were started from the outlet end of the pipe on the up-grade so that any water pockets in the fill would drain out of the pipe by gravity. The operations consisted of cutting out the earth from 1 to 2 ft. in front of the pipe so that the hole was 1 to 2 inches larger than the diameter of the pipe. The pipe was then jacked up to the face of the cut. Three sets of miners worked in 8 hour shifts.

A track of grooved timber was laid in the bottom of the pipe for a small wagon to remove the excavated material. Two fifty-ton jacks were used for jacking in the pipe. (See also Bulletin No. 8, page 93).

NEW STREETS OF GROUTED BRICKBATS. Small.

Old bricks broken by hand are being used as aggregate in cement macadam road construction in the city of St. Joseph, Montana, U. S. A. The broken bricks are laid between forms with expansion joints in place, compacted, and brought to correct profile. Cement sand grout of 1 : 2½ proportions is then deposited at a temperature of 70°F, Curing is done with wet burlap and straw and the pavement is kept closed to traffic for about a fortnight.

SEWAGE SLUDGE AS FERTILIZER.

A summary of the report of the Committee of Sewage Disposal of the American Public Health Association recently published is given in this article. The report calls attention to the possibility of wider use of sewage sludge as a fertilizer because of its nitrogen and humus content. Dijested sludge is comparable to farm manure. Fertilizing values of sludge are discussed and conclusions arrived at from investigations and data collected on the use of sludge as fertilizers are given.

NEW AIDS TO THE CONSTRUCTOR.

RELIEF MAP PROCESS.

A company has been organized in Washington to produce relief maps and pictorial copies in quantities, using a new method which has recently been patented. Three dimensional duplicates are made by a special hydraulic press, and maps with a relief effect are prepared by photographing the model under a slanting light.

ANTI-CORROSION COATING.

A plastic material which can be sprayed on with ordinary paint spray, equipment for the protection of concrete, wooden, and steel structures against corrosion and electrolysis has recently been placed on the market. It is known as " Amercoat " and forms a strong bond to concrete, steel, and wood.

No. 24—December 9, 1937.

An issue devoted to buildings that express new trends.

NEWS OF THE WEEK.

ROAD RESEARCH AT HIGH LEVEL.

A brief review of the reports and discussions at the Highway Research Board meeting held in Washington in the first week of December is given herein. Soil problems, roadside development and traffic safety were the main subjects discussed. Specific cases of foundation and embankment design were presented for discussion including bridge piers, cofferdams and embankments. The discussions brought out a wide range of opinion on soil action, principles of design, and methods of investigating soil properties. Soil stabilization was also discussed including soil mixture grading, chemical bituminous and cement admixtures, and factors affecting stabilization. Reports on engineering research embodied a number of interesting contributions to knowledge on vibration of pavement concrete, asphalt pavements, distribution of tyre pressure, strength of expansion joints, stresses on concrete slabs, and flexible pavement design.

AN INTRODUCTION TO BUILDINGS THAT EXPRESS NEW TRENDS. Bowman.

The editor in this article refers to new developments in building construction as exemplified by a number of recent buildings some of which are described in the present issue. Some features of this trend are walls of pressed steel sheets and cement asbestos sheets, the use of glass blocks in walls, welded steel frames, acoustical ceilings, cellular steel floors, and concrete floors that act as radiators.

TWENTY-SEVEN FORMS OF GLASS.

The office building of the Corning glass works in New York is described in this article. It is 100 ft. long by 27 ft. wide and is six stories high. The outside walls are of glass blocks divided into panels by extruded nickel silver trim. The interior walls are of smaller size glass blocks. Glass wool or fibrous glass is used in the wall expansion joints, as filler material in the air conditioning plant, as insulation in hot and cold water pipes and in tile form as acoustical ceilings. Radiator grills are of solid glass rods, and the stairway balustrade is built of hollow glass rods and discs. Plate glass doors, illuminated glass panels and grills, glass toilet partitions, wireglass windows in the air conditioning plant, glass picture frames, glass screws and bolts, and silver glass tiles in the entrance lobby are among the other glass products used which add up to a total of twenty seven. The glass block units are made of pyrex glass, and 3,800 blocks are used to make up 80 per cent. of the exposed wall faces. Interesting features of the glass block wall construction are briefly described. The general scheme of air distribution is also described. Steam heating is used in winter with the air conditioning system, while cooled air is used in summer.

MASONRY GIVES WAY TO STEEL.

The new research building of the American Rolling Mill Company at Middleton, Ohio, is described in this article. Notable features of this building are welded structural steel frames, walls of flanged galvanized steel plates 6 inches thick, porcelain enamelled steel sheets covering the exterior wall surfaces, glass block panels in the exterior walls, 3 inch thick metal interior partition walls, insulated metal roof with acoustical cork insertion, and an up-to-date air conditioning plant. The foundations consist of simple concrete footings and the floor is a 5-inch concrete slab. The construction of walls and roof is described with illustrations and a general description of the air conditioning system is given.

SCHOOL WITHOUT WINDOWS.

A new school building with glass block walls in a concrete frame which was recently completed in Elkader, Iowa, forms the subject of this article. The drawbacks of the usual designs of school buildings and the many advantages of the new design are stated. The building consists of a two storey reinforced concrete frame in which the floors cantilever beyond the columns at the exterior walls. The exterior walls of the building are of hollow glass block construction. The building is heated and air conditioned from a basement plant with distribution ducts placed in the ceilings.

GETTING READY FOR BIGGER AIRPLANES.

A new building having a floor area of 308 ft. by 453 ft. and containing no interior columns is under construction for a company of aeroplane manufacturers. The structural steel framework is enclosed in walls of brick and gunite. Ten roof trusses of 303 ft. span placed 50 ft. apart form the roof structure. Details of floor and roof construction and other accessory works are described.

CLEANING AIR ELECTRICALLY.

A new type of electrical apparatus for cleaning air has been installed in a building in Chicago. The apparatus is designed to give the floating particles of dust in the air an electric charge. These particles are then attracted to an oppositely charged plate in a manner similar to that by which iron filings are attracted by a magnet. The apparatus is briefly described.

OFFICE BUILDING WITHOUT PRECEDENT.

The new office buildings of Johnson & Son, wax makers of Racine represents an entirely new form of architecture and construction. The main building is one large workroom 130 ft. by 210 ft. in plan and 20 ft. high. Girdling this room on three sides is mezzanine gallery 18 ft. wide and 7 ft. high on which are located the offices of the executive heads. The fourth side of the main room faces a lobby 30 ft. high. The exterior walls are 15 inches thick up to mezzanine level and 11½ inches thick above. These walls are of special deep red brick on the faces with concrete and cork in between. A special feature which is the invention of the architect are tall tapering columns of reinforced concrete which rise from the floor and fan out at the upper end in the form of a wide circular petal cap. The columns are spaced at 20 ft. centres. The outside rim of the petal is wedge shaped to support a 2½ inch concrete slab filling in the areas between adjacent column caps. Fine wire mesh is placed over the petals and a finish slab is poured on top. The exterior walls have no windows but at a level of 6 ft. above the floor a band of glass encircles the whole building. Another band of glass forming the cornice runs round the whole building at the junction of the wall with the roof. These glass bands together with glass insertions in the roof slab provide natural light. Artificial light is also provided. Rising from a tunnel below first floor level to high above the roof of the building are two circular stacks housing the air conditioning plants and ducts. These are described by the architect as " two nostrils through which the workroom breathes ". The columns are 9 inches thick at the base increasing to 18 inches at the top and are of hollow construction. The petals over these cloumns are 18½ ft. in diameter. These columns are named " morning glory " columns. Details of walls, columns and roof construction are given with illustrations.

No. 25—December 16, 1937.

COMMENT AND DISCUSSION.

PAINLESS SQUARE ROOT.

A method of finding square root of large numbers with the slide rule is given and an example is worked out to illustrate the method.

TWISTED BAR STEEL.

The writer refers to an article on New York's New Building Code published in August 19 issue of the journal wherein it is stated that the working stresses in cold twisted twin bars were 50 per cent. greater than allowed in ordinary reinforcing bars. He considers these stresses excessive and gives reasons in support of his opinion.

FLOOD RUNOFF FORMULAS.

The author of the original article with the above title published in November 25 issue of the journal gives some additional information regarding some terms occurring in the formulas presented therein. Some corrections in the article as printed are also pointed out. (See page 92 of Bulletin No. 8.)

CONCRETE'S PERMANENCY.

The writer observes that in concrete bridges, many instances of deterioration in the superstructures have been noticed in spite of the use of waterproofing methods. These defects will in time become dangerous to the integrity of the structures. He is of opinion that there is an inherent weakness in the material concrete in itself as used in the past and as made today. For exposed superstructures concrete is no more permanent than wood or steel protected by treatment or painting.

OPERATING COUNTY ROADS FOR SAFETY. Smith.

Principal features of highway maintenance and management in Wayne County are described in this article. Special attention is devoted to making the roads safe for modern traffic.

ARMORED STEEL TRESTLE.

A trestle type steel bridge has recently been completed on the Colorado River below Parker Dam. Flood storage by Boulder Dam has decreased the maximum flood of the Colorado River from 200,000 cusecs to 75,000 cusecs so it was possible to provide a shorter bridge at this site than under ordinary conditions. The superstructure consists of four 36 inch steel I beams 8 ft. apart placed on piers 63 ft. centre to centre. The piers consist each of a row of eight H section steel piles driven 50 to 60 ft. below the stream bed. From a depth of 3 ft. below stream bed upwards these piles are cased in concrete and a 6 ft. deep concrete diaphragm connects the eight piles above low water level to provide lateral stiffness. The abutments consist of concrete decks resting on two transverse rows of steel piles. Steel bearing plates are welded to the top of the eight piles forming the pier, and a concrete cap carries the superstructure loads to the steel pile through the bearing plates. The decking consists of a 24 ft. wide concrete slab. Piling operations are briefly described, and bearing capacities with design loads are given.

MODERNIZING HEADWATER FORECASTING. Bernard.

An efficient flood forecasting service has recently been established by the State of Pennsylvania for getting better advance warning of unusual floods on four rivers in the State. The watersheds of the rivers are relatively small with concentration periods of 2 to 6 hours. Rainfall rates recorded as averages for 24 hours cannot be used in studies on watersheds of 50 to 500 sq. miles with short concentration periods. Therefore the first step in the programme was the establishment of about 130 rain gauge stations having 400 square miles as the average area served by each gauge. Fifteen additional streamflow stations were also installed. All the rainfall and streamflow stations are accessible over paved highways and experienced hydrologic engineers will travel on schedule visiting the stations, and charged with the duties of attending the gauges, assembling the charts and tabulating data for immediate use. The unit hydrograph method will be used to estimate streamflow from rainfall within the limits of existing data (see page 84 of Bulletin No. 5). A number of " index " watersheds have been selected which will provide in the early stages of a storm an indication of which its actual runoff coefficient is likely to be. Daily estimates of runoff potentialities will be prepared based on discharges ·from index watersheds. Hydrographs will be prepared from streamflow records, and the propagation of the flood wave will be traced at the forecasting centre. The streamflow will then be converted to river stage for points downstream for which the forecasting service is to be rendered. Recent developments in transmitting equipment will be used to bring to the forecasting centres data from distant stations of particular interest and a telephonic stage transmitter which utilizes a standard telephone line will be employed. Anyone wishing to read the gauge calls a certain telephone number in the usual way. The circuit is automatically held open for 6 minutes during which he uses a stopwatch to time the interval between audible stage signals. Dividing the timo by a constant gives the gauge height to one hundredths of a foot. Another new development is the automatic radio stage transmitter which eliminates the hazard of wire line failure, and is being used successfully.

DATA FROM ROAD RESEARCH.

Brief notes from papers presented at the Highway Research Board meeting held in Washington in the first week of December are given herein. A general review of the reports was published in the previous issue. These notes deal with road design in relation to speed, tyre pressure distribution, curving power of cars, soil stabilization, and concrete pavements. Methods of stabilizing earth roads with bituminous material and cement as carried out by a number of States are described and costs are given. In the case of concrete pavements, a study was made of early heat liberation of cements of various types as related to strength. The studies indicated that fine grinding of cement increased the maximum rate of heat liberation and that the strength of the cement was proportional to the total 24 hour heat liberation. Other subjects of investigation were corner stresses in slabs, bond strength of steel bars 3/8 to 3/4 inch diameter plain and deformed, expansion joints and vibration of concrete. A diagram showing measured stresses at the corner of a 6 inch concrete slab on clay subgrade under a corner load is given. Vibration of pavement concrete was found to be beneficial and results in saving of cement. Experiments were carried out to evolve a satisfactory filler for joints in brick pavements and a type of blended asphalt filler was found to be the best. Results of studies of 23 varieties of oil asphalts in respect of their physical properties are given.

No. 26—December 23, 1937.

NEWS OF THE WEEK.

Model studies of the Mahoning Dam, a major unit in the Pittsburgh Flood Control Project, will be carried out at the Case School of Applied Science. This dam is the largest of the nine dams included in the project and is of the gravity overflow type 800 ft. long and 150 ft. high. The model experiments will cost about $12,000. There will be 4 models : an enlarged section of the spillway crest and general profile of the dam to determine the best shape for the curvature of top of crest, and of the spillway basin at the foot ; an enlarged model of the sluiceway made of transparent material to study the flow through this ; a sectional model of the sluiceway for verification of results obtained from the transparent model ; and a model of the complete dam which will be tested to co-ordinate the findings of the previous tests on models of details of the structure.

COMMENT AND DISCUSSION.

HOW STIFF IS A BEAM ?

The beam deflexion problem offered for solution (see under Engineering News-Record, December 2, 1937) is analysed by the writer and a solution is indicated.

MONTANA'S LONE SWINGBRIDGE.

A temporary railroad bridge, which is under construction at Fort Peck Dam from materials available on the job, is described in this article. The bridge was erected as a swing bridge to allow for navigation of accessory floating plant being used in the construction of the Dam. The main span is a single track deck girder 120 ft. long fabricated from four 60 ft. girders taken from the old railroad bridge downstream of the Dam now filled in by the rising embankment. The span rests on a centre pier and two end piers, all of wood pile construction. When closed, its weight rests on all three piers ; when necessary to swing the bridge it is lifted clear of the end supports by four 50 ton ratchet jacks and then turned by cables pulled by a tractor on land. Details of lifting and swinging arrangement are described with illustrations. The wooden pile piers are also described.

SERVICING GROUT PUMPS. Simonds.
Minear.

Recommendations for selection, operation and maintenance of grout pumps based on experience gained by the writers in grouting the foundations and contraction joints of six western dams built by the U. S. Bureau of Reclamation are given herein. Special precautions to be taken with valves and liners of pumps are mentioned and the necessity of occasional flushing with water is emphasized. It is also necessary to remove hardened cement from inside and various chemical products reported to be very effective in dissolving hardened cement, thereby making its removal easy, may be used for the purpose.

GRAND COULEE HIGH DAM.

Plans have been announced and bids opened for the completion of the Grand Coulee Dam. The work already done includes excavating the foundations and placing concrete in the base of the dam. These works were characterized by some novel construction features such as freezing an arch of ice to stop a slide, and record speed in placing concrete with the aid of mechanical equipment. Plans for the dam have been revised several times since the inception of the project. Final plans as now announced provide for a straight gravity concrete dam 4,000 ft. long flanked at the west end by a smaller gravity dam 500 ft. long meeting the main dam at an angle and housing the irrigation supply pumps. At the centre of the main dam will be an overflow spillway 1,650 ft. long controlled by eleven drum gates each 135 ft. long and 28 ft. high. Surmounting the spillway is a multiple arch reinforced concrete highway bridge. The non-overflow section will contain 18 ft. diameter penstocks for the power plant and if surmounted by a highway. Outlet works consist of sixty 8½ ft. diameter conduits arranged in pairs in three rows differing 100 ft. in elevation from each other. The section of the dam is trapezoidal. Drainage and inspection galleries are provided.

The project is a combined power, river control and irrigation scheme. Part of the power developed will be used in pumping water from the Grand Coulee Reservoir to an irrigation supply reservoir which is 600 ft. above present river level. The pumping plant located in the subsidiary dam will consist of twelve pumps each with a capacity of 1,600 cusecs and capable of irrigating 120,000 acres.

The contractors have 1,460 calendar days in which to complete the work subject to a penalty of $2,000 a day for failure to do so. The total cost of the project will be $128,450,000 of which the dam alone will cost $118,123,000. Work on the balancing reservoir and canal system is not likely to commence until the dam is completed.

The Grand Coulee Dam will create a reservoir with a capacity of 10,000,000 acre ft. It is the key structure of the system of 10 dams proposed by the Corps of Engineers for development of the Columbia River, and is the uppermost of the series. A brief history of the development of the project from the first investigations up to the final plans is given. Sections of the dam showing details of penstocks, outlet pipes, and other features, and a diagram of the drum gate are given.

A NEW STADIA TECHNIQUE. **Oakey.**

In this article the author describes a modified levelling rod the use of which effects improvement in the speed and accuracy of stadia work. The levelling instrument also requires readjustment for use with this modified rod. The method of readjustment of instrument and the procedure used in taking stadia shots are described.

LOG-CRIB BRIDGES. **King.**

Bridges across torrential streams for forest roads in Oklahoma were constructed of log cribs filled with stone. One such bridge is illustrated and it is mentioned that it has withstood floods 15 to 20 ft. above them successfully.

BITUMINOUS ROADS STUDIED.

A brief review of the discussions and deliberations of the National Asphalt Conference which assembled at Memphis recently is given herein. Papers presented dealt with research problems concerning adhesion between bituminous materials and aggregates, weathering, hardening and cracking of asphalts, design of flexible surfaces and qualities of asphalts. Stabilization of base courses with bituminous materials was the subject of several papers. It was pointed out that bituminous materials that are most satisfactory for surfacing are not necessarily the best for base stabilisation. A stabilized material that has functioned satisfactorily as a wearing course, if subsequently covered with a bituminous material which eliminates evaporation losses, may fail completely due to softening resulting from the capillary rise of moisture. Details of the application of bituminous stabilization to roads in various parts of the U. S. A. were given in a number of papers. Cracking of the surface which was a chief cause of trouble in the past has been largely eliminated by seeing that the mixes are not overheated. Uses of asphalt other than for roads were the subject of four papers. These uses include asphalt mats for river bank revetment, asphalt paving for reservoir and canal lining, and for protection of earth dams from wave erosion.

No. 27—December 30, 1937.

NEWS OF THE WEEK.

COLORADO-BIG THOMPSON PROJECT APPROVED.

The Colorado-Big Thompson Project which will divert water from the Colorado River through a 13 mile tunnel under the continental divide to provide water for irrigation for lands on the eastern slopes of the divide has been approved for construction. Besides the tunnel and canal system the project includes two pumping plants and an initial installation for hydroelectric generation with a capacity of 30,000 k. w.

The Municipal hydroelectric dam at Paw Paw, Michigan, failed due to water breaking through the sand foundations on which the dam stood, creating a hole into which the power plant and spillway fell. The dam was a concrete structure 30 years old. Power house, spillway, water wheels generators, etc., completely disappeared and were found buried 15 ft. under water covered with sand.

PILEDRIVING IN DEBRIS FILL.

This article describes pile driving operations for the foundations of the west side express highway in New York city. This highway is being built on the extended shore line of the Hudson River which has been built up during the last century or so with stone filled cribs, rock fill and debris of all sorts. A previous article (see page 88 of Bulletin No. 8) dealt with caisson sinking for the foundations and the present one deals with the driving of about 130 miles of steel pipe piles and concrete piles. Foundation conditions met with are described. Details of types of piles, sizes, and depths are given and the driving operations of various types are described.

WORN PAVEMENT TOPPED AND WIDENED.

This article describes the resurfacing and widening of an old worn out road in Indiana. The work consisted of widening the existing 18 ft. road to 30 ft. by a new 12 ft. slab 9 inches thick at the edge decreasing to 7 inches 2 ft. from the edge, resurfacing the full 30 ft. with a minimum 5 inch slab of reinforced concrete and building sections of 9-7-9 inch reinforced concrete pavement where relocation was deemed advisable. About 2·3 miles are old brick pavement and 1·6 miles old concrete pavement. Separation sheets of tar paper were placed on the old brick surface and the new concrete was placed directly on the paper. The proportions of concrete used were: cement 620 lbs., sand 1,320 lbs., small gravel 1,386 lbs., and large gravel 994 lbs., with water ratio varying from 27 gals. to 30 gals. for the above batch. Transverse expansion joints were provided 40 ft. apart, and are of ½ in. pre-formed rubber with dowels. When the bottom of the expansion joint rested on the subgrade it was copper sealed. Curing was done with burlap and wet straw.

SALVAGE FROM SEWAGE. Rudolfs.

This article deals with the utilization of sewage for by-product recovery. Some of the present uses of sewage by-products include the utilization of sewage gas for power and plant treatment, the use of humus as a fertilizer, and the use of ash from incinerated material for road making and cement mixtures. Treated sewage is also used for fish culture, for irrigation, and for ponds, lakes, waterfalls, etc., in city parks. A number of possible uses are indicated such as recovery of alcohol and organic acids, hydrogen and carbon. The attention of research workers is drawn to these possibilities which offer unlimited scope for further investigations.

NEW ROCK DRILL DUST CONTROL.

A new method has been developed in New York for dust control in rock drilling work for the prevention of silicosis. The method depends on adequate ventilation at face of heading, and wet drilling. Details of equipment and operating methods are described with illustrations.

FORMULAS AND TABLES FOR COMPUTING CYLINDER INTERSECTIONS. Sack.

Mathematical solutions of some of the more common cases of computation of volumes common to intersecting cylinders are offered herein. Tabulated values for computation to a high degree of accuracy with minimum labour are derived from the mathematical solutions.

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No. 1—January 6, 1938.

COMMENT AND DISCUSSION.

SALVAGE FROM SEWAGE.

Four correspondents have stated their views in connection with an article by Dr. Rudolfs on by-product recovery from sewage. (See under Engineering News-Record, December 30, 1937 in this Bulletin). Instances of utilization of by-products as practiced in some States are given. One writer refers to the " death-dealing " characteristics of sewage which should be guarded against in the search for wealth from sewage. All the writers agree that great potentialities exist in the investigation of by-product recovery from sewage.

A STATUTE FOR RIVER DEVELOPMENT.

This article is an extract of the address of Mr. Arthur Morgan before the Interstate Commission of the Delaware River Basin in Philadelphia in which he outlines a procedure for unified control of interstate rivers. The first step is the establishment of a number of experienced and disciplined organizations which will see the problem as a whole without prejudice. Such organizations as state water control commissions, regional planning authorities and the national resources board are best suited for the purpose. The next rational step would be the enactment of a Federal law providing for the organization and administration of Federal interstate water control districts. The law should apply to entire river systems or to independent tributary systems. It should be effective wherever two or more States make a compact agreeing to its terms and providing for its application. Whenever it should be desired to set up an interstate water control district for any watershed, a petition would be made to the Federal Court of Appeals of the district where the major portion of the watershed lies, asking for the organization of an interstate water control district. The court would decide whether the petition is adequate and if so would tentatively appoint a director or board of directors to administer the proceedings and a board of appraisers to determine benefits and allocate costs. The directors would prepare a scheme and a working outline of policy including plans and estimates of construction. The entire project would then again be subject to judicial review and if it is finally approved, the district would be finally established. The financing of the work would be in accordance with the provisions of federal statutes and state compacts. The appraisers would allocate the costs in accordance with the benefits derived by the various parties.

GROUTING UNDER AN EARTH DAM.

This is a rolled earth and rockfill dam which has recently been completed on the Ogden River in Utah. It is 500 ft. long at crest, 61 ft. high above stream bed, and 102 ft. above the level to which the cut-off trench below it was excavated. The upstream slope is 3 : 1 covered with 3 ft. of rock riprap, and the downstream slope is 2¾ to 1. An open chute type concrete lined spillway controlled by three radial gates is provided on the right abutment rock and has a capacity of 10,000 sec. ft. The rock in both abutments is badly fissured and broken at the surface though quite solid underneath. A cut-off trench was excavated in the foundations and up the left abutment. A steel sheet-piling cut-off was driven to refusal in the cut-off trench. In the left abutment the sheet-piling was connected to bed-rock by a concrete wall. The cut-off was carried up the right abutment as a concrete wall from the end of the sheet-piling to the spillway structure. It was necessary to construct a system of tile drains in the cut-off trench to permit the placing of the earth embankment in the dry. These tile drains led to a central sump from which the collected water was pumped until the fill was sufficiently above the static head to cause no further difficulty. This drainage system was subsequently grouted and the work presented some unusual features. A description of the foundations and tile drainage systems is given. Numerous sand boils and springs developed on the floor of the cut-off trench and the remedial measures adopted are described. The grouting work in the foundations is described in detail and the results of the grouting operation are given.

ESTIMATING EARTH PRESSURES. **Newmark.**

The author presents a simple graphical method by which vertical earth pressures caused by foundation loadings can be computed with speed and accuracy. The theory underlying the method is briefly discussed and the procedure for solving a problem is described. An example is worked out to illustrate the method.

INDUSTRY TAPS AN UNDERGROUND LAKE. **Maratta.**

Details are described of a new type of well constructed by the Timken Roller Bearing Co. of Ohio. The well consists of a vertical shaft 148 ft. deep from the bottom of which screen pipes have been driven radially in a horizontal plane. Previously vertical wells were in use but they had a very short life due to rapid screen incrustation caused by the highly mineralized subsoil water. The provision of radial screen pipes placed horizontally to collect the water exposes a large area of screen which makes it possible to maintain a low velocity flow through the screen openings as well as in the adjacent ground. There is also a relatively small drop of pressure between the water in the pipe and that in the nearby ground when withdrawals of water are made. Under these conditions it is believed that no substantial encrustation can take place and the permanency of the supply will be assured. Details of the vertical shaft and the radial pipe collectors are given and the procedure of construction is described. Operating results are also given.

No. 2—January 13, 1938.

THE WEEK'S EVENTS.

The Colorado-Big Thompson project which will divert about 300,000 acre ft. of water annually from reservoirs on the Colorado River side of the Continental Divide to the basin of the south Platte River for irrigation, has been approved. The major item in the project is the Continental Divide tunnel 13·1 miles long, 9½ ft. in diameter with a capacity of 550 sec. ft. which will carry the water from the western to the eastern slope of the Divide. Water on the western slope will be stored in the Green Mountain Reservoir created by an earthen dam 258 ft. high and 1,000 ft. long at the crest on the Blue River, and the Granby Reservoir on the Colorado River which will be formed by an earthen dam 223 ft. high and 720 ft. long. Storage on the eastern slopes will be provided by three reservoirs formed by earthen dams. Power will be generated on the eastern slope.

COMMENT AND DISCUSSION.

A few further comments on Dr. Rudolfs' paper on " Salvage from Sewage " are published.

MODERN ROADBUILDING PRACTICE.

The new trends and methods in roadbuilding practice in America are described in a series of comprehensive articles as below :

GRADING OPERATIONS MULTIPLIED. Harrison.

Present tendencies in grade design necessitated by changes in design of highway line and profiles and in methods of fill construction are discussed.

BETTER SURFACING AHEAD.

Notes by a number of experts on advances in constructing asphalt, brick, concrete, tar, and stabilized soil surfaces are given. For stabilized soil roads two general procedures are adopted : (1) providing the soil with coarse and fine material of the proportions and character required to produce stability and possibly supplementing this by adding chemicals that attract moisture ; and (2) incorporating water insoluble binder in fine grained or poorly graded soils, compacting the mixture and surfacing this base with a wearing course. For the first procedure generally deliquescent salts such as calcium or sodium chloride are used and for the second bituminous materials or cement are used. Intensive research has been carried out for the last three years on soil cement mixtures. It has been demonstrated that the compaction of a soil cement mixture to uniform maximum density at optimum moisture with sufficient cement incorporated for stability and durability will produce a roadway at low cost capable of carrying secondary road traffic successfully. Full laboratory testing however must precede construction to insure satisfactory results. Stabilization with salt (sodium chloride) has been tried in Indiana and results are described.

THIS YEAR'S ROAD MATERIALS.

This article summarizes improvements in the roadbuilding materials including brick, asphalt, concrete, crushed stone, sand, gravel, tar, etc. New applications are also described.

RESEARCH AIDS INCREASED. Kelley.

This article describes important developments in laboratory and field experimentation in road materials during the past year. The study of the soil has become important in road engineering and the principles of soil mechanics are being put to practical use increasingly.

DESIGN PERFECTS LINE AND PROFILE. Toms.

Trends in road design with regard to alignment, grades, curves, cross profiles and intersections are briefly summarized.

ROADBUILDING EQUIPMENT TRENDS.

Developments and improvements in road building machinery during the past year are described herein.

No. 3—January 20, 1938.

NEWS OF THE WEEK.

SILT TRANSPORTATION COURSE OFFERED AT IOWA UNIVERSITY.

A graduate student course on the transportation of silt and detritus is to be offered by the Department of Mechanics and Hydraulics of the Iowa University. The course will cover theory, analysis of observations, and sampling methods for studying the movement of suspended solids and bed load by flowing water. Engineering applications such as erosion of channels, retrogression below dams, and control of sediment in branching channels and intakes will be emphasized. The course is offered by Prof. E. W. Lane, Associate Director of the Institute of Hydraulic Research and Prof. M. T. Mavis.

COMMENT AND DISCUSSION.

Comments on Dr. Rudolfs' article dealing with salvage from sewage are offered by two correspondents.

DEEP PIERS FOR BATON ROUGE BRIDGE.

A new highway and railway bridge is being built over the Mississippi River at Baton Rouge. Two of the main piers of this bridge will go to a depth of 180 ft. below low water level and a third will be 160 ft. The piers are being sunk by the sand island method. The pier foundations consist of concrete caissons which will be of cellular construction. For four of the piers which are deeper than the others, open dredging will be employed, the bottom being sealed with concrete. Factors determining the location of the site of the bridge are discussed and a description is given of the sand island method of sinking caissons. Brief details are given of the approaches and other subsidiary works.

PROGRESS ON CENTRAL VALLEY PROJECT.

This article describes the progress of work on the Central Valley Project in California which was started last October. The first work undertaken was the construction of the first four miles of the Contra Costa Canal which is to be 50 miles long with a discharge of 350 cusecs at the head. The project includes two dams, preliminary investigations for fixing the location of which have been completed, and work is in progress on warehouses and houses for the staff, etc.

INFLUENCE LINES BY MOMENT DISTRIBUTION. Kruys.

In this article a method is described of obtaining influence lines for the moments at the joints in continuous frames by the Hardy Cross method of moment distribution.

NEW TEST DATA ON PAVING BRICK.

At the annual meeting of the National Paving Brick Association held recently discussions mainly centred on test results and tests in progress or to be undertaken. Research has been carried out and is in progress on paving bricks, and a design practice is being worked out that unifies the brick, the joint filler, the bedding course, and the base, into an integral structure. The research work so far carried out is briefly described. Analysing the reasons for adopting de-aired brick for paving the roadway of Lincoln tunnel in New York city, Mr. Bowden of the Port of New York Authority outlined comparative tests of de-aired brick and granite paving blocks. De-aired brick was found to be superior to granite as regards surface hardness, toughness, etc.

No. 4—January 27, 1938.

COMMENT AND DISCUSSION.

PROFIT FROM SEWAGE TREATMENT.

Mr. Whitehead refers to Dr. Rudolfs' article on "Salvage from Sewage" and says that the lure of making a profit out of sewage purification has caused much loss of public money in the past. The recovery of single by-products from sewage sludge is so beset with difficulties that he would regard with more favour efforts directed towards encouraging a back-to-the-land movement of the whole mass for fertilizing purposes.

RECREATION DAM BUILT IN MIAMI RESERVOIR. Eiffert.

A low concrete dam submerged in times of flood has been constructed about 300 ft. above the Englewood flood control dam of the Miami Conservancy District. This dam creates attractive ponds in the Englewood Reserve, a recreational area of 900 acres. It is 150 ft. long and 9 ft. high. Hydraulic characteristics which determined the design of the dam are discussed and calculations for the design are given in outline.

EQUIPMENT PASSES IN REVIEW. Richardson.

This article contains a description of all machines and materials on display at the 1938 Road show at Cleveland. These include excavators and loaders of various sorts, haulage units, rollers, concrete and aggregate equipment, equipment for bituminous construction, compressed air apparatus, and pumps.

HAWAII BUILDS LONG RIGID FRAME. **Bartels.**

A reinforced concrete rigid frame bridge with a main span of 125 ft. and two cantilever side spans of 28½ ft. each built on the Kauai Island is described in this article. The structure consists of three ribs of a uniform thickness of 2 ft. with depths varying from 4½ ft. at the centre to 9 ft. at the haunches in the main span, and 3½ ft. at centre and 8 ft. at the haunches in the cantilever spans. The main girders have parabolic haunches. The analysis of the frame was made by the method of fixed points, and moments, shears, reactions, etc., were determined with the help of influence lines. A temperature variation of ± 30°F. and the effect of shrinkage, were considered in the design.

NEW AIDS TO THE CONSTRUCTOR.

A new motor driven internal type concrete vibrator has been put on the market. It consists of an electric drive motor mounted on two small wheels, a variable length of flexible shafting and a vibrating tool which is to be immersed in the concrete.

No. 5—February 3, 1938.

NEWS OF THE WEEK.

RECORD ICE JAM AT NIAGARA FALLS WRECKS FAMOUS ARCH BRIDGE.

This article gives a detailed description of the failure of the steel arch bridge at Niagara falls due to the pressure of an ice jam in January last. The structure and its foundations are described together with a history of the site. The conditions leading to the failure and the nature of the failure are described with a number of photographs showing views of the wreckage.

STEEL ROOF SUPPORT HAS 300-FT. SPAN.

A three-hinged steel roof arch on cantilever arms having a span of 300 ft. for a livestock arena is described herein.

BIG STONE LAKE LEVEL RESTORED BY WHETSTONE RIVER DIVERSION.

Big Stone Lake is a recreational lake on the boundary line of Southern Dakota and Minnesota States. Its level began to fall some years ago. Recently a project has been completed whereby the waters of the Whetstone River are diverted through an artificial channel 4,100 ft. long to the lake which has been restored to its former level. Details of this project are described in this article. The Whetstone River is a tributary of the Minnesota River and was largely responsible for aggravating spring flood conditions in the latter river. By its diversion to the lake a measure of flood control on the Minnesota River has also been provided.

PROGRESS IN USE OF TREATED TIMBER. Tratman.

This article is a review of the proceedings of the annual meeting of the American Wood Preservers Association held recently. Various technical, economic, and commercial aspects of the preservative treatment of timber and the uses of treated timber were discussed.

No. 6—February 10, 1938.

Annual Review Number.

AN EDITORIAL REVIEW OF 1937.

The editor reviews the progress during 1937 in the United States in the field of engineering. Important developments in the field of river engineering included flood control planning for a number of rivers basins. The enormous reclamation programme included 35 projects in 13 States on which 60 to 70 million dollars were spent during the year. The Columbia Basin project with its main feature the Grand Coulee Dam was the outstanding reclamation project of the year. Fewer power plants were built during 1937 despite steadily growing demand. A number of important bridges including the Whitestone bridge of 2,300 ft. suspension span and the Baton Rouge Bridge on the Mississippi were started during the year.

STATUS OF MAJOR PROJECTS.

Brief reports of progress made during 1937 on large construction projects in the civil engineering field with notes as to work remaining to be done are given herein. The works mentioned include the Colorado River Aqueduct, the Parker Dam, the Conchas Dam, the Rio Grande Canalization Project, San Gabriel rock-fill dam, Bonneville Dam, the All-American Canal, the Central Valley Project, the Kendrick (Casper-Alcova) Project, the Fort Peck Dam, and the Grand Coulee Dam.

WATER RECORD OF THE YEAR. Hoyt.

A summary of rainfall, river flow, temperature and water supply conditions in the United States is given in this article. A map showing departure from normal of rainfall in various States is included.

SURVEYS OF ENGINEERING FIELDS.

Eight authorities in special spheres of engineering activity herein present concise analyses and reviews of developments that have taken place during 1937, as below :—

PROGRESS IN STRUCTURAL KNOWLEDGE. Dewell.

Reinforced concrete holds the largest promise of increased and wider use in structures, and European thought and practice are considerably in advance of the work of the conservative American engineer. The accomplishments of the French Engineer Freyssinet in the production of high strength concrete and in the pre-stressing of reinforcements deserve note. Some important reinforced concrete structures completed during the year in America are mentioned. Progress in the field of structural steel, timber, and brick is described and an account is given of research in connection with earthquake resistance in buildings at various centres.

BRIDGE ENGINEERING IN 1937. Gemeny.

The majority of bridges constructed during 1937 were for highway service. Research and thought aiming at the improvement of the quality of concrete seem destined to broaden its use for bridges in future. A growing insistence on esthetic merit in bridges is noticeable. A number of special types of light-weight bridge floors have been developed. Efforts are being made to produce a cement which will consume all the water and expand in setting, thereby making possible a dense concrete of high strength.

WATER SUPPLY AND TREATMENT. Gayton.

HYDRAULIC KNOWLEDGE. Stevens.

Knowledge of hydraulics has made rapid progress during the past few years and the works of Prandtl, Von Karman, Nikuradse, Schiller, etc., which have brought to hydraulics an understanding of factors such as turbulence roughness, etc., have modified our conceptions of many hydraulic phenomena. Hydraulic models have become an indispensable too linking theory and practice. Throughout the world an astonishing amount of hydraulic research is under way, for the most part by models. The river studies carried out at the Waterways Experiment Station at Vicksburg have proved the possibilities of new methods of control. The subject of toe scour at dams has been successfully tackled with models and the works of Rehbock, Bakhmeteff, Schoklitsch in this connection are mentioned. In the field of hydrology the most important development is the idea of predicting spring run-off on mountain streams by systematic snow surveys on their headwaters.

SURVEY OF SEWAGE TREATMENT. **Gascoigne.**

FLOODS AND FLOOD CONTROL. **Knappen.**

January 1937 produced the most disastrous floods in the Ohio basin and a preliminary flood control plan was prepared. Further studies will be made before any of the works are finally adopted. Flood control works in a few other States which were under construction during the year are described in brief.

DEVELOPMENTS IN SOIL KNOWLEDGE. Gilboy.

This article gives a summary of developments in soil mecahanics during the past year and of their applications to construction problems. An important step is the attempt to verify laboratory predictions by careful measurements of settlement in actual buildings. Tests are in progress in a building in Boston. Other investigations include a study of the relations between the plasticity characteristics of clay and its compressibility in the undisturbed state, and studies of the stability of earth slopes. Taylor has analysed the effect of rapid lowering of water level against the face of a saturated slope. A more rational basis of design of earth dams proposed by the author of this article is being studied. Stability of cohesionless soils and the design of embankments on yielding foundations are other subjects which have been investigated, and are briefly discussed.

CIVIL ENGINEERING RESEARCH. Hollister.

Progress in soils and hydraulic research, in analytical methods of stress determination in structures, and in railway and road research during the year are briefly outlined.

No. 7—February 17, 1938.

COMMENT AND DISCUSSION.

A EUROPEAN VIEW ON SEWAGE SALVAGE.

Mr. Hkessener from the Hague comments on Dr. Rudolfs' paper on Salvage from Sewage. In America the large sewage purification schemes constructed during the last few years are mostly of a purely destructive character and Dr. Rudolfs' viewpoint is essentially a result of, or even a reaction to this development in sewage disposal in America. In Europe, the hope of salvage or even profit from sewage has long hampered the development of sewage purification and has not been beneficial to the cause of clean streams. The author considers that the production of such chemicals as mentioned by Dr. Rudolfs from other cheap materials of a less complicated and a more consistent nature has lately made so much progress and will make so much progress in the near future that sewage slugde would not stand a chance.

EDITORIAL.

WHO PAYS FOR POWER ?

In the past when a power company built a dam across a navigable river thus improving its navigation, no part of the cost was charged to improved navigation. A few years ago, the government went into the power business and among other dams for power, built the Bonneville Dam which will serve both power and navigation. Recently the Federal Power Commission announced the way in which the cost of the dam is to be allocated. According to this allocation general taxpayers are to bear 43 per cent of the cost because of the improvement in navigation. The editor questions the justification of allocating a substantial portion of the cost to taxpayers and discusses the question at length.

IMPROVING LOCK AND DAM CONCRETE. Rohwedder.

Studies of concrete on the formation of air bubbles, causes of sand streaking, workability, cement requirements, strength, proper aggregate grading and the property of water retention of the cement, were made by the U. S. Army Engineers in connection with the locks and dams in the upper Mississippi River. These studies and their results are reported in this article. Factors which decrease the formation of air bubbles in vibrated concrete were determined from the tests. The property of water seperation in cements was studied with various types of cement and it was found that the amount of water given off decreases as the fineness of the cement increases. Because of the increased ability of fine ground cements to retain water the new specifications for the works required the use of fine ground cement. The increased water retaining power of cement reduces the trouble from " bleeding " and sand streaking which make the surface of the concrete unsightly though the trength and durability remains unimpaired. The relation between the maximum size of aggregates and quantity of cement required to produce a given workability was also investigated, and the results obtained are given. Effect of curing temperatures on the compressive strength of concrete placed and cured in water was studied and the general conclusion arrived at was that higher water temperatures produce higher strength for concrete placed under water. If 24 hours of air curing can precede submersion maximum strengths are obtained.

COTTON IN ROADBUILDING. Myers.

Cotton fabric for the surfacing of roads and airport runways, for curing concrete pavement and for lining irrigation ditches has been used in some 35 States during the last two years. These uses are described in this article. The fabric used is of a coarse mesh with 9 to 12 threads per inch. An irrigation canal in Idaho has been lined with this fabric. The sides and bottom of the canal were first covered with a coat of asphaltic material at the rate of ½ gallon per square yard. The cotton fabric was next applied with 1 ft. of fabric extending beyond the upper edges of the slopes. The fabric was tacked down with metal strips. The fabric was then covered with two coats of asphaltic material at the rate of ½ gallon per square yard for each coat. It is too soon to forecast the results of this experimental lining.

CONCRETE VIADUCT TESTED TO DESTRUCTION. Butler.

A reinforced concrete viaduct which skirts the base of a very steep slope recently gave way under the weight of a landslide. The viaduct consisted of continuous slab spans 14 inches thick carried on reinforced concrete bents spaced 14 ft. to 15 ft. apart. The details of typical characteristics of the failure are described in this article. A study of the collapsed structure indicates the forces in action due to enormous load, side thrust and impact in a structure.

No. 8—February 24, 1938.

THE WEEK'S EVENTS.

FOUNDATION CAUSED DAM FAILURE.

Squeezing out of pockets of plastic material in the foundation caused the failure of Wyandotte County Lake Dam according to the report of a board of engineers appointed to investigate the failure. It was an earth dam with puddle clay core 1,550 ft. long and 80 ft. high. It failed by slumping of the downstream bank for half the length of the structure. The underlying rock was found to be sound but the material overlying the rock was found to contain a large percentage of clayey soil. The failure resulted from a plastic movement of this overlying clayey soil under the load of the dam. The board reported that the dam may safely be reconstructed if the base is widened from 500 ft. to 1,000 ft. and if the area underlying the downstream portion is cleared to bedrock.

STUDIES OF BEACH EROSION. Brown.

The Beach Erosion Board was created by an Act of Congress in 1930 for the purpose of making investigations and studies on beach erosion problems. An experimental tank was constructed by this Board in which a model beach could be subjected to any desired variation of attack by model waves, tides and currents. It consisted of a concrete basin 24 ft. × 12 ft. × 3 ft. deep with arrangements to supply water at both ends. Waves in the tank were produced by a plunger type wave machine moved by an electric motor. A tidal apparatus similar to a water stage recorder was developed to regulate tidal heights in the tank. The wave and tide producing equipments are briefly described with the manner of working them. A considerable number of preliminary experiments were carried out in order to arrive at a suitable scale for the model operations to be conducted in the wave tank. A comparison was made between the wave action and period in nature and in the tank, and ultimately a time scale ratio of 1 to 3 was arrived at for the model. The vertical scale was obtained by comparison of normal and storm waves in nature with model waves producing the same effect of backwash and having the same general appearance and came to 1 to 24. With the time and vertical scale obtained as described above, the horizontal scale was found from Froude's law for model scale and came to 1 to 14·7. Some of the experiments carried out in the model tank are then described and included studies of beach erosion under wave attack, the effect of the additional factors of storm and normal tides on beach erosion, the effect of a vertical bulkhead at mean high water on the movement of beach sand, and the possibility of forming a barrier beach under wave action normal to the shore.

WAVE TANK BUILT AT WASHINGTON.

The experience gained in the tank studies described above led to the design of a larger tank 85 ft. × 24 ft. to provide much more flexibility in conducting erosion studies. Details of the new tank which is under construction, and of the improved tide regulating mechanism to be installed there are given.

MORE ON SALVAGE FROM SEWAGE. Garner.

In this article the author gives his views based on experience in England on sewage by-product recovery. Experience in England point to wider use of sludge as fertilizer and the desirablity of grease recovery. The presence of much grease is detrimental to the use of sewage sludge as a fertilizer. Mechanical processes for dealing quickly with fresh sludge seem to offer better prospects of a wider use of sludge as a manure.

FROM FIELD AND OFFICE.

PULVERIZING SOIL SAMPLES. Litehiser.

Description of a pulverizing apparatus for preparing soil samples for test which is used in the Ohio State high way testing laboratory is given herein.

THE HIGHWAY MAGAZINE.

January, 1938.

THIS BRIDGE HAS "NINE LIVES".

During the floods of 1937 a number of small bridges were undermined by the flood waters in the Ohio State. Amongst these were a number of corrugated plate arch bridges under a road in the Miami River

Valley, which were of 19 ft. span. Although the footings and headwalls were destroyed the large plate arches were not damaged. They were lifted out and used in other bridges which were under construction.

JOURNAL OF THE AMERICAN CONCRETE INSTITUTE.

Vol. 8.

No. 5—May-June 1937.

Notes on Inspection of Structures in Europe. **Boase.**

The author describes briefly some important structures in Europe including bridges and buildings. In the construction of the Marine Station of Havre Harbour, "treated concrete" piles were used for the foundations. This new development in reinforced concrete, due to Mr. Freyssinet, is briefly described. Treated concrete consists of a well proportioned mix, vibration, pressure and pre-stressing of steel. The manufacture of the treated concrete piles used is described, and other directions in which Mr. Freyssinet is utilizing his new product are mentioned. Other structures described include reinforced concrete bridges in France, and a few buildings in London, and other large cities of Europe.

Recent Developments in Foundation Design—with Special Reference to Concrete. **Proctor.**

Recent advances in foundation engineering are described with reference to a number of recent major foundation installations which include the Caisson foundations of piers of San Francisco—Oakland Bay Bridge and of the Mississippi river bridge at New Orleans, and the foundations of the Palace of the Soviets in Moscow.

Recent Developments in Pile Foundations. **Upson.**

(For abstract see page 55 of Quarterly Bulletin No. 8.)

Discussions on the following papers are also given.

1. Effect of Plastic Flow and Volume changes on Design.
2. Portland-Puzzolan Cement as used in the Bonneville Spillway Dam.

JOURNAL OF THE AMERICAN WATER WORKS ASSOCIATION.

Vol. 29.

No. 7—July 1937.

The Future of Water Allocation and Developments in Interstate Agreements. **Minard.**

Public and private water rights and the law with regard to interstate streams are discussed in relation to future developments of water resources. Legal barriers put in the way of interstate agreements by local interests are discussed. A solution for better development of interstate rivers is also indicated and lies in Federal control and an association of state Commissions.

ENGINEERING EXPERIMENT STATION NEWS, THE OHIO STATE UNIVERSITY.

Vol. IX.

No. 5—December 1937.

Ohio Stream Flow, Flood-Flow and Drainage-Area-Size Relation. Youngquist.

On the basis of data for the 1936 flood in Connecticut which exceeded all floods previously known in the history of the State, a curve showing discharges with reference to drainage area was obtained by Mr. Bigwood and from this curve he deduced an equation relating the discharge to the drainage area. In this article the author examines how far this curve is applicable to the discharges in Ohio which occurred during the January 1937 flood. He concludes that the curve envelops the maximum flood discharges in the Ohio occuring in 1937 but it does not do so in the case of the 1913 record flood in the Ohio. This shows that the equation obtained for discharge in terms of drainage on the basis of Connecticut figures is not applicable to the Ohio river basin.

PROCEEDINGS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

Vol. 63.

No. 10—December 1937.

Earthquake Stresses in an Arch Dam. Nelidov.

Bergen.

" In this paper formulas are developed for determining the stresses due to the horizontal effect of an earthquake on an arch dam for two different conditions : first, the acceleration of the earthquake is assumed to occur along the canyon, that is horizontally upstream ; and second the acseleration is assumed to occur across the canyon, that is horizontally at right angles to the first condition. The vertical effect of the earthquake is omitted from consideration because of its minor importance. Arches with hinged ends as well as with fixed ends are considered, and illustrative numerical examples are given. The derivation of the formulas are based on Castigliano's Theorem of Least Work ".

GRAPHICAL REPRESENTATION OF THE MECHANICAL ANALYSES OF SOILS. Campbell.

A method of graphical representation of grain-size distribution of soils is proposed in this paper. A semi logarithmic co-ordinate system is used with the grain sizes plotted as abscissas on a logarithmic scale and cumulative percentages by weight plotted as ordinates. The author has plotted the results of mechanical analyses of six types of soils selected from numerous samples. He explains the system of classification proposed by him with reference to the mechanical analysis graph. Other methods of classification are also discussed.

ECONOMIC ASPECTS OF ENERGY GENERATION : A SYMPOSIUM.

PROGRESS IN THE GENERATION OF ENERGY BY HEAT ENGINES. Orrok.

The author gives estimates of the total power producing machinery used in the United States in 1936 and discusses hours of use and kilowatt hours of work done annually showing the contrast between 1880 and 1936. The size and type of units with the average economics of various types of machinery are given. Tables are given for the cost of steam power. Internal combustion engines are discussed and possibilities of other mediums of heat supply are reviewed. It is concluded that steam will be the most used medium of power generation in the near future.

HYDRO-GENERATION OF ENERGY. Rogers.

" This paper reviews briefly the important design features of modern high head and low head turbines ; discusses the importance of laboratory testing ; points to six important mechanical improvements in turbine design made since 1925 and concludes with an examination of possible future developments such as the pumped storage plant and the use of propeller type turbines for higher heads ".

IMPROVEMENTS IN THE UTILIZATION OF ENERGY. Justin.

Recent development in the increased use and decreased cost of electrical energy is outlined herein. The paper traces the development of long distance transmission, of regional power companies and of the co-ordination of steam and hydroelectric power development, and shows the effect of these factors on the utilization of electric energy. Attention is directed to peak load hydroelectric plants as a means of reducing the total cost of energy in a system including both steam and hydroelectric plants.

COST OF GENERATION OF ELECTRIC ENERGY. **Sporn.**

This paper contains a general discussion on the cost of generation of electric energy and the cost of transmission and distribution. Economics of steam power and water power are discussed and it is shown that in most cases present day steam power can be produced more cheaply than water power. The relative merits of hydro and steam plants are briefly discussed. It is shown that there is no economy in long distance transmission of electric energy and that sound economics require the location of generating plant near the load. Costs of distribution are briefly discussed and it is pointed out that at least for residential and general factory use the cost of distribution is the major item in expenditure for service. In reviewing future trends in costs of generation and transmission of power the author concludes that trends are definitely downward.

SOCIAL IMPLICATIONS OF TECHNOLOGICAL TRENDS IN THE POWER INDUSTRY. **Freeman.**

" The general effect of trends in energy generation on the level of living, un-employment, over-production, and population distribution are treated in this paper. A plea is made for a clear distinction between the business point of view and that of the social reformer ".

ELECTRIC POWER IN ECONOMIC PERSPECTIVE. **Thresher.**

The author discusses the effect of public and private ownership on the progress of power industry and deals with the economic factors in the growth of power industry.

VOL. 64.

No. 1—January 1938.

STREAM POLLUTION IN THE OHIO RIVER BASIN : A SYMPOSIUM.

The following papers are included.—

SURVEYS FOR STREAM POLLUTION CONTROL. **Streeter**

LOW-FLOW REGULATION BY PYMATUNING RESERVOIR. **Ryder.**

This reservoir has a capacity of 8,365 million c. ft. and has been built in north western Pennsylvania. The primary purpose of the reservoir is to conserve water during the winter and a spring months with the object of regulating the flow of the Shenango River and the Beaver River of which the former is a tributary, during periods of low flow. An augmented regular water supply was badly needed to meet the requirements of public water supply, sanitation, industrial water supply, navigation and power in the valleys of the two rivers. Flood control in the valleys is also provided for by the reservoir. Prior to the construction of the reservoir the construction of sewage treatment plants in the valleys was contemplated in view of low flow and increased load on filtration plants. Such treatment was considered unnecessary after the construction of the reservoir because the increased regulated supplies in the rivers would provide dilution water in a quantity sufficient to assimilate reasonably treated sewage and industrial wastes. Tests are being made to determine the minimum flow required for dilution purposes and the criterion for future release from the reservoir will be the requirements for sanitation and public water supplies. The effect of the reservoir in reducing flood crests at some points in the valley below are discussed and it is shown that the reservoir was successful in reducing flood discharge in the rivers during the floods of March 1936.

SANITATION PROBLEMS INCIDENTAL TO FLOODS. Stevenson.

Planning of water works subject to danger from floods, and emergency work to be done by the sanitation staff during and after floods are outlined in this paper.

PROGRESS IN POLLUTION CONTROL IN THE OHIO RIVER BASIN. Tisdale.

PLANNING FOR POLLUTION CONTROL AT PITTSBURGH, PENNSYLVANIA. Davis.

STREAM POLLUTION PROBLEMS AT CINCINNATI, OHIO. Root.

WHAT CAN BE DONE ABOUT STREAM POLLUTION ? Wolman.

PRELIMINARY DESIGN OF SUSPENSION BRIDGES. Hardesty.
Wessman.

A rapid and accurate method of analysis for the preliminary design of the stiffening trusses of suspension bridges is presented in this paper. Hitherto three methods of analysis have been in use: the elastic theory method, the deflection theory method, and the trigonometric series method. The first method is now obsolete and its equations are misleading and erroneous. The second method, though exact, involves long and tedious computations of a complicated nature. The third method is also lengthy and involved but the authors have modified it and have developed a number of equations from which an analysis may be made quickly. A detailed description of the method is given together with the equations derived. Computations illustrating this preliminary design method are worked out for the Triborough suspension bridge.

Structural Behaviour of Battle-Deck Floor Systems. — **Lyse. Madsen.**

Results of two years of investigations of the behaviour of battle-deck flooring for bridge decks are reported in this paper. Four one-third size models and one full sized floor panel were tested under the action of a concentrated wheel load. The battle-deck flooring acted as an integral unit distributing the wheel load over various stringers. The plate acted with the stringer so as to form a T beam which if taken into account in design would result in an economy of 10 to 15 per cent. The test results give a basis on which to formulate a rational design method for battle-deck floor systems.

Relative Flexure Factors for Annalyzing Continuous Structures. — **Stewart.**

" An effective method of analyzing the movements in continuous structures by using the geometrical properties of elastic curves is offered in this paper ".

Water-Hammer Pressures in Compound and Branched Pipes. — **Angus.**

In two previous papers, the author has derived the principal equations for water-hammer and has given the theory in some detail. This paper gives an outline of the theory and explains a graphical constructions for the solution of water-hammer problems in pipes. Illustrations are given of the applications of this method to parallel pipes, pipes with dead ends, surge tanks in systems, pipes leading from reservoirs and having two branches, the effect of gate closure on turbine and draft tubes and a pumping system. In all these cases variations of pressure and velocity with time is found for various points in the system. Experimental studies confirm the accuracy of the method.

No. 2—February 1938.

Engineering Economics and Public Works : A Symposium.

The following papers are included :

Advantages of Orderly Planning. — **Fay.**

Influence of Public Opinion. — **Mead.**

Hazards of Uneconomical Construction. — **Riggs.**

An Appeal to Reason. — **Wilgus.**

For Summaries see under " Civil Engineering " (New York) in this Bulletin.

FLOOD ROUTING. Rutter.
Graves.
Snyder.

" A method used for routing floods through the Tennessee River is described in this paper. First, a method for routing floods in the natural condition from Knoxville, Tenn. to the mouth of the Tennessee River was developed and then the procedure was adapted to routing through the reservoirs of authorized and proposed projects ".

The river was divided into seven reaches. In routing a flood through a reach it is necessary to know (1) total inflow into reach (2) profile of water surface at any instant (3) storage under the profile. The storage equation " inflow minus outflow equals change in storage " is then applied to the reach and the solution of the equation gives the outflow. Total inflow into each reach was determined day by day from the calculated outflow of the adjacent upstream reach, published discharges of metered streams flowing into the reach and an inflow estimtated from rainfall on the unmeasured areas draining into the reach. Total flood volume at each dam site was assumed to be known. The storage in the reach for various flows was determined from topographic maps and cross sections of the river valley in conjunction with profiles determined from backwater curves. The outflow was then derived from the relation between storage and discharge for the reach.

The general procedure is described and a detailed example is worked out for one reach. The method is useful in studying past floods and in forecasting flows for desirable operations of dams as future floods occur.

DESIGN OF PILE FOUNDATIONS. Vetter.

" It is intended in this paper to prevent rational methods for the determination of stresses in the individual piles of a pile foundation which supports a rigid structure such as a bridge pier, or a hydraulic gate pier ".

The investigation is confined to pile foundations having all piles parallel and symmetrical with respect to a vertical plane of symmetry and to structures in which the resultant of all outside forces including dead loads, is located in the plane of symmetry. Three types of pile foundations are invastigated :

(*a*) foundations consisting of two pile groups, all piles in each group being parallel with each other,
(*b*) foundations having all piles symmetrical about a vertical line and
(*c*) piles in more than two directions and not parallel with each other.

Formulæ for the various cases are developed. An actual example of a reinforced concrete pile bent is worked out to illustrate the methods described in the article.

FLOOD-PROTECTION DATA. PROGRESS REPORT OF THE COMMITTEE.

This report sets forth the progress made in the collection of flood data, mentions some of the important techinical reports concerning floods that have been published during 1937, and reviews the position with regard to the publication of floods data in a systematic form making certain recommendations. The effect of meteorological conditions on floods is discussed and it is mentioned that a group of specialists had been organized by the U. S. Weather Bureau to undertake systematic research work relating to the meteorology of floods. The Committee emphasizes the need of detailed information regarding large floods in respect of meteorological conditions, synchronism in the arrival of flood crests from tributaries, flood heights noted on permanent structures, and extent of flood damage. The importance of collecting data pertaining to cloudburst floods is also stressed.

DISCUSSIONS ON THE FOLLOWING PAPERS APPEAR IN ONE OR MORE ISSUES OF THE PROCEEDINGS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS GIVEN ABOVE :—

GRAPHICAL DISTRIBUTION OF VERTICAL PRESSURE BENEATH FOUNDATIONS.

PROGRESS REPORT OF THE COMMITTEE ON FLOOD-PROTECTION DATA.

NATIONAL ASPECTS OF FLOOD CONTROL : A SYMPOSIUM.

PRESSURES BENEATH A SPREAD FOUNDATION.

EFFECT OF DOWEL-BAR MISALIGNMENT ACROSS CONCRETE PAVEMENT JOINTS.

SOIL REACTIONS IN RELATION TO FOUNDATIONS ON PILES.

PRE-STRESSED REINFORCED CONCRETE AND ITS POSSIBILITIES FOR BRIDGE CONSTRUCTION.

THE DESIGN OF ROCK-FILL DAMS.

DESIGN OF REINFORCED CONCRETE IN TORSION.

ECONOMICS OF THE OHIO RIVER IMPROVEMENT.

PRACTICAL APPLICATION OF SOIL MECHANICS : A SYMPOSIUM.

HYDRAULIC TESTS ON THE SPILLWAY OF THE MADDEN DAM.

ECONOMICS OF HIGHWAY-BRIDGE FLOORINGS OF VARIOUS UNIT WEIGHTS.

Practical Use of Horizontal Geodetic Control.

Solution of Transmission Problems of a Water System.

Interaction between Rib and Superstructure in Concrete Arch Bridges.

Flow Characteristics in Elbow Draft-Tubes.

Measurement of Debris-Laden Stream Flow with Critical-Depth Flumes.

Graphical Representation of the Mechanical Analyses of Soils.

Economic Aspects of Energy Generation: A Symposium.

Stream Pollution in the Ohio River Basin: A Symposium.

THE RECLAMATION ERA.

Vol. 27.

No. 12—December 1937.

New Contract Covers Completion of the Grand Coulee Dam. Hutton.

Some features of the Grand Coulee Dam which is being constructed on the Columbia River are described in this article. This dam is the principal feature of the Columbia Basin Project which will ultimately irrigate 1,200,000 acres of rich desert land in Central Washington, regulate the flow of the Columbia River, and develop electrical energy to be used in pumping for irrigation and for several other purposes. The power plant at Grand Coulee will be the largest in the world with an annual capacity of 8,320,000,000 kilowatt hours of firm power and 4,200,000,000 kilowatt hours of secondary power. The dam will raise the water in the storage reservoir about 300 ft. above the ordinary river level and pumps will raise it about 280 ft. more to a balancing reservoir from which it will flow by gravity to the lands to be irrigated. The dam will impound 10,000,000 acre ft. of water and the reservoir created will extend to the international boundary 151 miles away. Work done so far has included some unique construction methods and many world's records in construction have been made. The world's largest cofferdam extending 3,000 ft. and enclosing an area of 60 acres was constructed to protect the construction area from summer floods. The sheet piling required for this cofferdam was 127 miles in length and totalled 17,000 tons in weight. Excavation at the dam site exceeded 20,000,000 cubic yards. Over 2,000,000 cubic yards of concrete have already been placed and 6,000,000 cubic yards will be placed under the new contract for the completion of the dam.

SHASTA DAM TO BE WORLD'S SECOND LARGEST CONCRETE DAM.

The Shasta Dam is the key unit of the Central Valley Project in California which will irrigate about a million acres in the Sacramento and San Joaquin basins. Construction of the dam will start after the reconstruction of 37 miles of the Southern Pacific Railroad now located within the proposed reservoir site, negotiations for which are now in progress. The dam will be a straight concrete gravity structure 3,100 ft. long and 560 ft. high creating a reservoir of 4,500,000 acre ft. capacity. In mass, it will be larger than the Boulder Dam but smaller than the Grand Coulee Dam which is under construction. The dam will serve a number of purposes, namely, irrigation, flood control navigation and power generation. The Shasta Dam is one of two large dams on the Central Valley Project. The other, Friant Dam on the upper San Joaquin River will be 3,300 ft. long and 260 ft. high, creating a reservoir of 450,000 acre ft. capacity.

DESCHUTES PROJECT IS APPROVED.

This project is designed to provide irrigation water for 50,000 acres of dry but fertile lands near Madras, Oregon. The principal features of the project are a dam on the Deschutes River designed to conserve and divert 209,000 acre ft. of water, a main canal 65 miles long with a steel siphon 7,660 ft. long across the Crooked River, and smaller canals and subsidiary structures. The dam will be an earth embankment 3,100 ft. long and 83 ft. high flanked by auxiliary embankments 14,900 ft. and 3,600 ft. long respectively. The main canal will be located largely through rock cuts and would require considerable concrete and gunite lining.

PROBLEMS PECULIAR TO IRRIGATION FARMING. Israelsen.

Some of the problems of irrigation farming are discussed in general in this article. Storing water is one of the most important problems and hundreds of millions of dollars have been spent for this purpose. Storage may be surface or underground. The problem of storage requires a comprehensive study of water resources and of distribution of water for irrigation. The means of conveying stored water from reservoirs to irrigated areas offer other problems with which the irrigation engineer has to deal. In the case of underground storage, the suitable capacity of pumps, the rate of pumping so as to avoid annual water draft in excess of the annual recharge, and means of providing artificial recharge are problems which have got to be faced. In the application of irrigation water to the fields every irrigation farmer is directly faced with problems of soil moisture, soil percolation and capillarity etc. Soils vary over a wide range and their properties have to be studied to derive the greatest benefit from the irrigation water available. The agricultural engineer's assistance is necessary for the farmer to find the methods and procedure that will assure highest efficiency with economy. The farmer must know how much moisture there must be in his soil so that his crops can grow satisfactorily. He must learn to interpret the appearance of his crop with respect to its water requirement and should know how long it will take him to fill the capillary reservoir of his soil. He should be able to understand the elements and practices of water measurement. He must guard against rise of the water table and the consequent alkali menace by adequate underdrainage. The privileges peculiar to irrigation farming greatly outweigh the problems met with, and irrigation farming is now a permanent, sound and substantial branch of American agriculture.

VOL. 28.

No. 1—January 1938.

DAM CONSTRUCTION IN PROGRESS AT THE BEGINNING OF 1938. Swanton.

A brief account is given of the state of progress of the dams under construction by the Bureau of Reclamation. These include concrete and earth dams of various types. The dimensions are given and the work done so far is described.

FIRST CONCRETE PLACED IN THE MARSHALL FORD DAM, COLORADO RIVER PROJECT, TEXAS.

Concreting has started at this dam. The principal features in the construction plant are an aerial tramway 1½ miles long for transporting aggregate from the gravel processing plant, a gravel washing and classifying plant, a mixing plant, automatic weighing and batching devices, and a stiff led derrick for placing concrete.

SOIL SCIENCE.

VOL. 43.

No. 3—March 1937.

SAMPLING SOIL FOR THE pH DETERMINATION. Eddins.
Scoville.

A soil sampler, which has proved to be very useful and convenient in taking samples from the upper 8 inches of sandy soils for the determination of pH values by the quinhydrone method, is described in this article.

JOURNAL OF THE COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH, AUSTRALIA.

Vol. 11.

No. 1—February 1938.

Experiments on the Use of Timber in Structures.

The use of timber for structural purposes has greatly increased, particularly in Germany and the United States. Dry or partially dry softwoods are used for structural purposes overseas but in Australia slow drying green hardwoods are almost invariably used. An important problem to be investigated is the unsightly sagging of timber beams under long continued loading and a preliminary series of experiments to obtain data for use in design has been initiated.

THE JOURNAL OF THE DEPARTMENT OF AGRICULTURE, VICTORIA, AUSTRALIA.

Vol. XXXV.

Part 7—July 1937.

Irrigation of Sultanas in the Swan Hill District. Penman.
Skene.
Walters.

Soil moisture properties and irrigation practices are investigated in this article for a number of soil types carrying sultanas in the Swan Hill District. Rate of loss of soil moisture and efficiency of irrigation as judged by the wetting of soil have been studied. Rational use of water and application of methods designed to improve soil permeability are discussed. Recommendations providing a basis for irrigation technique on individual soil types are given.

JOURNAL OF THE INSTITUTION OF ENGINEERS, AUSTRALIA.

Vol. 9.

No. 11—November 1937.

Thin Drag-spread Bituminous Road Surfaces. Mathieson.
Gawith.

This paper deals with thin bituminous road carpets laid on existing pavements or prepared bases. The changes in grading which occur in service are discussed, with examples from existing roads. Theoretical gradings are considered and methods of laying are described, with costs.

No. 12—December 1937.

THREE SPAN LIGHT SUSPENSION BRIDGE OVER HASTINGS RIVER AT KINDEE CROSSING, N.S.W. — **Karmalsky, Britton.**

This paper describes a suspension bridge of three spans for light traffic. The central span is 220 ft. and the side spans are 88 ft. A special feature of the bridge is the trussed cables from which the deck is suspended, and no stiffening girders are provided at deck level. The trussed cables consist of an upper and a lower cable interconnected with diagonals consisting of two angle pieces rivetted together to form a start section. The diagonals and the cables are connected through gusset plates. Hangers for the deck are of round mild steel bars. The cables are anchored to mass concrete blocks buried in the approach embankments. The decking consists of timber planking on longitudinal timber stringers carried on timber cross girders. Piers consist of braced timber trestles supported on concrete blocks. The design of the trusses is described and method of calculation is given.

DISCUSSIONS AND COMMUNICATIONS.

THE DESIGN AND CONSTRUCTION OF COMPOSITE SLAB AND GIRDER BRIDGES. — Knight.

Mr. D. F. O'Donoghue comments on the above paper published in January 1934 issue of this journal. An analysis of the final stresses allowing for normal forces between concrete and steel is made.

RANDOM NOTES ON CONSTRUCTION COSTING. — Jeater.

A system of cost keeping of construction works is described herein. Points in its use and application are considered and the advantages and disadvantages are discussed.

SINKING OF SMALL SEWAGE PUMPING STATION CAISSONS. — Henning.

The construction of the concrete sub-surface structure consisting of a circular concrete well of 14 ft. 6 inches inner diameter about 22 ft. deep of a number of sewage pumping stations is described. The sinking operations of the wells and the difficulties and problems encountered are detailed, with the methods of dealing with them.

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Nothing of interest to irrigation engineers in this issue.

PUBLICATIONS OF VARIOUS GOVERNMENTS, INSTITUTIONS, SOCIETIES, ETC.

INDIA.

Central Government.

Department of Labour.

RULES GOVERNING THE SUBMISSION OF ESTIMATES FOR, AND THE CONSTRUCTION OF, IRRIGATION WORKS, THE COST OF WHICH EXCEEDS THE POWERS OF SANCTION OF PROVINCIAL GOVERNMENTS.

COPY OF A LETTER DATED 22ND MARCH 1929 FROM THE SECRETARY TO THE GOVERNMENT OF INDIA, INDUSTRIES AND LABOUR DEPARTMENT, P. W. BRANCH, TO THE SECRETARIES TO THE GOVERNMENTS OF BOMBAY AND PUNJAB, P. W. D., FORWARDING A COPY OF THE REPORT OF THE INDUS DISCHARGE COMMITTEE, 1929.

In a previous report the Indus Discharge Committee suggested the provisional adoption of a formula correlating discharges at any two consecutive points on a river. This formula was of the form of a linear equation. Subsequent considerations led to the conclusion that the relation between discharges at two consecutive points is a complex one and could not be correctly represented by a linear equation. Mr. Wilsdon, Scientific Research Officer of the Government of the Punjab, carried out some researches on this problem at the instance of the Committee and the conclusions arrived at by him are briefly summarized in the report. The effect of withdrawals in the Punjab on the river supply at Sukkur are then discussed on the basis of the data collected during the course of the gauging operations. The conclusion arrived at is that it would be unjustifiable to withdraw from the Indus at Kalabagh the perennial supply required for the Lesser Thal Project. On the basis of the data it is not possible to say that this supply can be taken without materially affecting the supplies allotted to the Sukkur Barrage Project. It is recommended that all idea of any new canal drawing its water from the Indus should be held in abeyance for 10 years during which the gauging operations should be continued. A certain small perennial supply not exceeding 1,250 cusecs during winter months from 15th October to 20th April, can be made available for utilization in the Punjab from the tributary components of the river Indus. The Committee say that should the Government of the Punjab desire to proceed with the Haveli Project they see no difficulty in making available the volume of approximately 7,500 cusecs required from 20th April onwards. With regrad to the proposal for a dam on the Sutlej at Bhakra, the Committee are of opinion that the quantity of water available is sufficient but the only objection which can be raised against it is its effect on the inundation canals in Sind. They recommend that in view of the complexity of the problem, the two Governments concerned should place two Superintending Engineers on special duty to make joint investigation and submit a joint report upon it. The committee also make certain remarks about the future work to be undertaken by the officers in charge of the gauging operations and by the Discharge Committee. They recommend the appointment of a competent statistical staff by each of the local Governments concerned.

In the letter forwarding the copy of the Committee's Report to the two Governments, the Government of India have enquired whether the Provincial Governments are prepared to accept the recommendations of the Committee.

NOTES ON REINFORCED BRICKWORK, VOL. II. P. W. D. TECHNICAL PAPER No. 38, 1923. — Brebner.

This volume contains illustrations, experiment tables giving data of tests, comparative tables, plates, curve tables, and plans of certain buildings actually constructed.

Indian Stores Department.

FAILURES OF RAILWAY MATERIALS, DEALING CHIEFLY WITH FERROUS METALS. — Wraight. Hinde.

This pamphlet describes cases of failure of railway materials examined by the Metallurgical Inspectorate, Indian Stores Department and is compiled from official records of the Department for the information of railway officials, manufacturers of materials and others interested.

Finance Department.

PUBLIC WORKS ACCOUNT CODE WITH APPENDICES, FIRST EDITION—REPRINT, 1935.

The accounts maintained in respect of Public Works transactions, the principles on which they are based and the procedure to be adopted in their maintenance, are described.

Education, Health and Lands Department.

HAND-BOOK OF COMMON WATER AND MARSH PLANTS OF INDIA AND BURMA, 1936. HEALTH BULLETIN No. 24, MALARIA BUREAU No. 11. — Biswas. Calder.

This publication deals with the characteristics, distribution, and life history of aquatic plants associated with malaria-carrying mosquitoes. The methods of controlling the growth of such plants are also discussed.

CATALOGUE OF CIVIL PUBLICATIONS, GOVERNMENT OF INDIA, CORRECTED UP TO 31ST MARCH 1937, WITH MONTHLY LISTS OF ADDITIONAL PUBLICATIONS FROM APRIL 1937 TO JANUARY 1938.

Institution of Engineers (India).

BYE-LAWS OF THE INSTITUTION OF ENGINEERS (INDIA).

BENGAL.

Department of Irrigation.

ANNUAL IRRIGATION REVENUE REPORT FOR THE YEAR 1935-36.

This report briefly describes the activities of the Irrigation Department during the year. Important works which were under execution are mentioned and a list of other works carried out is given. The only important project which was under construction during the year was the Damodar Canal Project which is designed to irrigate 200,000 acres of paddy land. The work was practically completed during the year. Other works included the maintenance of a large number of navigation canals and rivers, dredging of shoals, revetment work, maintenance of embankments, and the construction of some bridges. Financial results are given of some of the more important irrigation and navigation works. The surveys carried out by the Department include the aerial survey of a part of the Padma River, surveys of the Brahmaputra, Attarbanka, and Gumti, survey of a reservoir area for the More Reservoir Project and a survey for the Darkeswar reservoir project. Hydraulic data on important rivers were also observed and recorded. The Anderson Weir which was damaged due to an unusually high flood in the Damodar in August 1935 was being repaired. Statements showing details of canals in the Presidency, capital accounts of irrigation, navigation, embankment and drainage works, receipts and recoveries, financial results of all works and administrative accounts are appended.

NOTE BY MR. C. ADDAMS-WILLIAMS, C.I.E., LATE CHIEF ENGINEER, IRRIGATION DEPARTMENT, BENGAL ON THE LECTURES OF SIR WILLIAM WILLCOCKS, K.C.M.G., ON IRRIGATION IN BENGAL TOGETHER WITH A REPLY BY SIR WILLIAM WILLCOCKS, 1930.

Sir William Willcocks delivered a series of lectures on " Ancient System of Irrigation in Bengal " at the University of Calcutta in 1930. His contention was that the dead rivers of Bengal were artificial canals which once distributed the silt laden floodwaters of the main rivers all over the country, fertilizing the soil and keeping off malaria. In recent years Bengal is troubled with the problem of devastating floods and the spread of malaria. Sir William Willcocks accused the Irrigation Department of Bengal for the present state of affairs which has come about during the last 70 years due to the failure of the Department to train the Ganges and other rivers. In the present note the Chief Engineer for Irrigation in Bengal has refuted the arguments put forward by Sir William Willcocks and holds that the dead rivers are merely channels of rivers which have shifted their course, a process which is well known to be associated with delta formation of rivers. Detailed replies are given to points raised in the lecture.

A reply to the note by Sir William Willcocks is also included.

ANNUAL REPORT ON MAJOR RIVERS IN THE NADIA RIVERS DIVISION FOR THE YEAR 1933-34.

ANNUAL REPORT ON MAJOR RIVERS IN THE NADIA RIVERS DIVISION FOR THE YEAR 1934-35.

ANNUAL REPORT ON MAJOR RIVERS IN THE NADIA RIVERS DIVISION FOR THE YEAR 1935-36.

These reports contain information on general conditions, changes of course, bank erosion and formation of shoals relating to 13 large rivers controlled by the Division including the Ganges and Brahmaputra. Topographical details of the rivers are briefly described, important changes observed during the year are discussed and details of floods during the year are given. Data relating to cross sections at fixed sites, discharges and surface slopes observed by the Department are tabulated. An account of the navigation features in the rivers is given and the causes of deterioration of some reaches in respect of navigation are discussed. Work done in the training of shoals and proposed works for improvements in various rivers are mentioned.

ANNUAL REPORT ON MAJOR RIVERS IN THE RIVER TRAINING WORKS SUB-DIVISION, DACCA FOR THE YEAR 1934-35.

ANNUAL REPORT ON MAJOR RIVERS IN THE RIVER TRAINING WORKS SUB-DIVISION, DACCA FOR THE YEAR 1935-36.

ANNUAL REPORT ON MAJOR RIVERS IN THE RIVER TRAINING WORKS SUB-DIVISION, DACCA FOR THE YEAR 1936-37.

These reports give a brief history, hydraulic features, and descriptions of any notable changes that have taken place during the year for 20 rivers controlled by the Sub-division including the Padma, Meghna, and Brahmaputra. Details of shoals, erosion and the dredging work carried out are given. Navigation facilities in the rivers are described. Data of gauges recorded and water surfaces slopes observed are given.

ANNUAL REPORT ON MAJOR RIVERS IN THE KHULNA SUB-DIVISION AND IN THE FARIDPUR AND BAKARGANJ DISTRICTS FOR THE YEAR 1934-35.

ANNUAL REPORT ON MAJOR RIVERS IN THE KHULNA SUB-DIVISION AND IN THE FARIDPUR AND BAKARGANJ DISTRICTS FOR THE YEAR 1935-36.

ANNUAL REPORT ON MAJOR RIVERS IN THE KHULNA SUB-DIVISION AND IN THE FARIDPUR AND BAKARGANJ DISTRICTS FOR THE YEAR 1936-37.

These reports describe changes in the principal features of certain major rivers in the Khulna Sub-division and in the Faridpur and Bakarganj Districts. Navigation features are described and data on tides, flood levels and hydraulic slopes as observed are given. Formation of shoals in some of the rivers and the consequent deterioration in navigation are discussed.

Legislative Department.

BENGAL ACT V OF 1864 (THE CANALS ACT, 1864) AS MODIFIED UP TO THE 1ST JANUARY, 1917.

This is an act to amend and consolidate the law relating to the collection of tolls on canals and other lines of navigation and for the construction and improvement of lines of navigation in Bengal.

BENGAL ACT VII OF 1866 (THE BENGAL EMBANKMENT ACT, 1866) AS MODIFIED UP TO THE 18TH FEBRUARY 1915.

An Act relating to the acquisition of land for embankments and other matters relating thereto. This Act was modified by subsequent Acts.

BENGAL ACT NO. VI OF 1873 (THE BENGAL EMBANKMENT ACT, 1873).

This Act provides for the better construction, maintenance and management of embankments and watercourses in Bengal. This Act was subsequently repeated in part by the Bengal Embankment Act of 1882.

BENGAL ACT VI OF 1880 (THE BENGAL DRAINAGE ACT; 1880) AS MODIFIED UP TO THE 1ST JULY 1919.

This is an act to provide for the drainage and improvement of lands in Bengal. Rules and regulations pertaining to schemes and plans for the drainage and improvement of any tract of land are given.

BENGAL ACT II OF 1882 (THE BENGAL EMBANKMENT ACT, 1882) AS MODIFIED UP TO THE 15TH JUNE 1930.

This is an Act to make better provision for the construction, maintenance, and management of embankments and watercourses in Bengal. Powers of Collector, procedure in case of imminent danger to life or property, powers of the engineer, acquisition of land and compensation, costs of works and apportionment thereof, penalties, etc., are embodied in the Act.

BENGAL ACT NO. II OF 1902 (AN ACT TO AMEND THE BENGAL DRAINAGE ACT, 1880).

BENGAL ACT NO. IV OF 1915 [THE BENGAL EMBANKMENT (SUNDARBANS) ACT, 1915].

This is an Act to extend certain enactments relating to embankments to the Sundarbans area.

BENGAL ACT V OF 1920 (THE BENGAL ALLUVIAL LANDS ACT, 1920) AS MODIFIED UP TO THE 1ST JUNE 1935.

This is an act to prevent disputes concerning the possession of certain lands in Bengal gained by alluvion or by dereliction of a river or the sea.

BENGAL ACT XII OF 1934 (THE BENGAL WATERWAYS ACT, 1934).

This act provides for the maintenance and improvement of waterways in Bengal. A Board of Trustees invested with special powers for carrying out the objects of this Act was constituted by the Act, and is called the Bengal Waterways Board. Rules and regulations for the constitution of the Board, appointment of Chairman and Trustees, powers and duties of the Board, conduct of business of the Board, execution of works by the Board, financial powers of the Board and other related matters are given.

BENGAL ACT IX OF 1936 [THE BENGAL ALLUVION AND DILUVION (AMENDMENT) ACT, 1936].

An Act to further amend the original Act of 1847.

CATALOGUE OF GOVERNMENT PUBLICATIONS AVAILABLE AT BENGAL GOVERNMENT PRESS, ALIPORE AND WRITERS' BUILDINGS, CALCUTTA CORRECTED UP TO 30TH SEPTEMBER 1937.

BIHAR AND ORISSA.

Department of Irrigation.

THE FLOOD PROBLEM IN ORISSA : A PRELIMINARY NOTE, 1937. Visvesvaraya.

The Government of Bihar and Orissa appointed a Committee of three experienced engineers to investigate the flood problem of Orissa in 1927. The Committee made a detailed inspection of the area and submitted a final report in 1928, in which certain recommendations were made. This note discusses problems relating to floods in Orissa on the basis of the report of the Flood Committee of 1928 and makes recommendations with regard to the action to be taken and measures to be adopted in dealing with them. The principal recommendations and conclusions of the 1928 Committee are briefly summarized. The Committee were of opinion that flood control reservoirs on any of the reservoirs were not practicable. They recommended the abandonment of a number of canals which were originally constructed for irrigation in 1903-4. Suggestions were made for the opening up of some estuaries and constructing cuts through the sand dunes along the sea coast to allow of free passage of floods. New embankments were considered undesirable and certain existing embankments were recommended for abandonment. The Committee also recommended the appointment of a special staff for flood protection work exclusively. Very little has been done so far to give effect to the recommendations of the Flood Committee, the main reason being want of funds.

The author of the present note emphasizes the need of a systematic investigation of the flood problem and the collection of hydraulic data for all the rivers. Particulars of areas requiring protection along each river should also be collected. He suggests the preparation of a preliminary estimate of costs of the various control works which have been proposed by the 1928 Committee as well as of other works which may be suggested in the course of future investigations. These estimates may then be reviewed by the Government who will decide upon the works to be taken up first.

With regard to the Flood Committee's opinion that reservoirs are not practicable in any of the rivers, the author considers it necessary to investigate the question more fully. Flood control reservoirs are considered possible on enormous rivers like the Mississippi and the Ohio in America. Above the city of Hyderabad Deccan not far from the catchment of the Mahanadi, one of the principal rivers flowing through Orissa, two reservoirs were constructed which proved of great value for protecting the city from floods as well as for irrigation and water supply. The author recommends the appointment of special staff for the investigations outlined above. A Committee of three engineers consisting of the Chief Engineer of the Province and two expert engineers from outside to supervise the flood control investigation and survey work is also considered necessary. The author does not favour the abandonment of the irrigation canals as recommended by the Flood Committee because of their value in drought periods. The note concludes with a summary of the recommendations detailed above and some general remarks on the manner of dealing with the problem.

THE BIHAR AND ORISSA IRRIGATION ACT, 1918.

This is an act amending the Bengal Irrigation Act, 1876 which applied to the Province before its separation from Bengal. Amendments to some of the sections of the original Act as made are given.

THE BIHAR AND ORISSA PRIVATE IRRIGATION WORKS ACT, 1922.

This act relates to the repair and maintenance of private irrigation works, regulation of the supply or distribution of water from such works, and their construction, extension, and alteration. The powers of Government with respect to private irrigation works are defined in the Act and procedure is laid down.

THE BIHAR AND ORISSA MINOR IRRIGATION WORKS ACT, 1922.

This act makes provision for the control of irrigational resources of rivers and for the construction, improvement, and maintenance by Government of irrigation works in the Province.

Department of Agriculture.

ANNUAL REPORT ON EXPERIMENTAL FARMS IN BIHAR AND ORISSA FOR THE YEAR 1935-36.

This report describes the work done at twenty seven Government Experimental Farms in Bihar and Orissa during the year. The experimental work included manurial and varietal trials of sugarcane, paddy, wheat, barley and other crops. Irrigation trials included the determination of yields of different types of sugarcane on irrigated and non-irrigated land. Increasing attention is being paid to the selection of suitable early and late ripening varieties of cane and heavier yielding mid-season canes of higher sucrose content.

GOVERNMENT OF BIHAR CATALOGUE OF PUBLICATIONS CORRECTED UP TO 31ST DECEMBER 1936.

UNITED PROVINCES.

Department of Irrigation.

IRRIGATION ADMINISTRATION REPORT OF THE UNITED PROVINCES FOR THE YEAR ENDING MARCH 31, 1937.

The report contains financial results of irrigation works, areas irrigated during the year, results of navigation in canals, a description of rainfall and flood conditions in the irrigated tracts of the Province, an account of works completed, proposed, and in progress, and brief details of researches carried out. The research work included investigations of losses on canals and watercourses, lining of canals with various types of lining, silt theory investigations, and experiments with various types of silt selective heads. Construction was nearing completion on the Ganges Canal Hydroelectric grid and Tube-Well Schemes, and progress was made with the Fyzabad Electricity and Gogra Pumping Scheme. Surveys were carried out in Mirzapur District and Rewa State to investigate the possibilities of generating power from the Vindhyan rivers. A few tube well schemes and river pumping schemes for the irrigation of the Eastern Districts were also investigated. The report is accompanied by a number of statements showing areas irrigated by canals and by crops, canals and reservoirs in the Province, financial results of irrigation works, assessment of water rates, and schedule of water rates.

PROJECT ESTIMATE FOR REMODELLING MAT AND HATHRAS BRANCHES IN THE UNITED PROVINCES, NOVEMBER 1935—MARCH 1938.

Rohatgi.

For Note see under Works Section in this Bulletin.

STABILITY DIAGRAMS AND CALCULATIONS FOR THE GHAGAR DAM, MIRZAPUR CANALS, UNITED PROVINCES WITH A NOTE ON THE LEAKAGE THROUGH THIS DAM.

This is a masonry dam forming the Dhandraul Reservoir in the Mirzapur District in U. P. It is a masonry structure 68 ft. high of trapezoidal section, the width at the base being 46 ft. and at the top 10 ft. The upstream face slope is 1 in 12 and the downstream slope is 3 in 5. Stability diagram of the dam, and stress diagrams for different sections are given. The dam was tested for tension, crushing and sliding.

There has been some leakage under the dam through the fissures in the rock on which the dam is founded, amounting to about 30 cusecs. Grouting of the fissures in the rock near the upstream base of the dam resulted in half the leakage being stopped.

The geological formation consists of badly fissured rock in reefs of varying thickness dipping upstream at an agle of 30 degrees. The rock is of siliceous sandstone.

MANUAL OF ORDERS, IRRIGATION BRANCH, P. W. D., UNITED PROVINCES OF AGRA AND OUDH, VOLS. I AND II.

These volumes contain the administrative and executive rules and procedure of the United Provinces Irrigation Department. Volume I deals with the organization of the Department, duties of various officers, matters concerning establishment including transfers, leave, dismissals, resignations, etc., travelling allowance rules, rules regarding recruitment to services, powers of various officers, budget and accounts rules, rules for preparation of projects, contract rules, office procedure and maintenance of registers and records, and land acquisition. Volume II covers legal and revenue matters including the Canal Acts with rules issued thereunder, rules for the guidance of canal magistrates, distribution of water supply, assessment of rates, rules for the lease of land, and water rates in force. Appendices including list of registers and records to be maintained in various offices, schedule of owners and occupiers rates, and questionnaires for the guidance of officers when inspecting offices under their control. This is the fourth edition of the publication, corrected up to October 31, 1936 (together with up-to-date correction slips).

INSTRUCTIONS ON REPAIRS AND OTHER ITEMS FOR THE USE OF CANAL SUBORDINATES, FIFTH EDITION, 1929.

The instructions in this pamphlet are intended as a guide to subordinates in carrying out maintenance and repair work on canals. Specifications for limes, mortars, brickwork, concrete, pointing, plaster, pitching and earthwork are given in brief. Instructions regarding maintenance of roadways on canals, canal bridges, clearance and inspection of channels, maintenance of banks of channels, silt clearance, outlets, jungle clearance and maintenance of drains are given. It includes rules for the maintenance of Inspection Houses and their furniture, etc., and maintenance of ironwork and woodwork at regulators. The duties of the subordinate in connection with regulation, discharge observations, attendance at officers' camps, and on the occasion of transfer are stated. Instructions for maintenance of plantations and sowing new plantations are included.

CATALOGUE OF PUBLICATIONS ISSUED BY THE GOVERNMENT OF THE UNITED PROVINCES CORRECTED UP TO 30TH JUNE 1937 TOGETHER WITH SUPPLEMENTARY LIST FOR THE QUARTER ENDING 30TH SEPTEMBER 1937.

CENTRAL PROVINCES.

Department of Agriculture.

REPORT ON DEMONSTRATION WORK CARRIED OUT IN THE EASTERN CIRCLE TOGETHER WITH REPORTS ON THE SEED AND DEMONSTRATION AND CATTLE-BREEDING FARMS OF THE CIRCLE FOR THE YEAR ENDING THE 31ST MARCH 1937.

This report describes the activities of the Agricultural Department in the Eastern Circle of Agriculture in Central Provinces. Brief details of research work in connection with paddy, wheat, and sugarcane are given. Work at the demonstration farms is described with details of outturns of various crops grown. Profit and loss accounts of the farms are given.

CATALOGUE OF PUBLICATIONS, GOVERNMENT OF CENTRAL PROVINCES AND BERAR, CORRECTED UP TO 1ST JUNE 1937, WITH SUPPLEMENTARY LIST OF PUBLICATIONS FROM SEPTEMBER 1937 TO MARCH 1938.

PUNJAB.

Public Works Department (Irrigation Branch).

STATISTICS OF IRRIGATION WATER DISTRIBUTION AND WORKING OF DISTRIBUTARIES OF THE CANALS IN THE PUNJAB FOR THE YEAR 1933-34.

The following statements and diagrams relating to canals in the Punjab are included.

1. Statement showing discharges, escapes, and water utilized during the year.
2. Abstract of irrigation in acres in each district.
3. Working statistics showing discharges, areas commanded and irrigated, duties, depths of water, and costs of maintenance of canals distributaries and minors.
4. Water consumption diagram.
5. Statement of rainfall.
6. Water supply diagrams.

Hydrographs of rivers showing discharges at the sites of headworks of the various canals during the year are also included.

STODDARD-HARVEY IMPROVED IRRIGATION OUTLET, 1918.

This note describes the design and special features of a type of outlet, the discharge of which varies at the same rate as the discharge of the distributary varies above and below the full supply level discharge. It consists of an adjustable orifice connected by a rectangular masonry pipe to a narrow broad crested weir which discharges into a flume. The orifice is fixed at the bed level of the channel.

HARVEY'S IRRIGATION OUTLET, 1919.

Mr. W. H. Harvey of the Punjab Irrigation Department designed a type of flumed outlet the discharge through which is independent of downstream conditions. This device is of special value in the case of a group of outlets in a distributary or a tail cluster of outlets on a minor or distributary. A sketch of this design is given and its use on a number of channels is described. The outlets were found quite successful. The particular advantages of this type are discussed, and the various other conditions in which it can be used with advantage are described. It acts as a semi-module outlet, can be used as a meter in any point in a channel, and is specially advantageous as a small or low fall of ·3 to 1·0 ft. in a channel. It can also be used for holding up the discharge to required levels at any point in a channel is a good pattern of head for a heavily silting minor with a small available head into it, and for non-regulated minors.

HISTORY OF BALLOKI HEADWORKS, LOWER BARI DOAB CANAL FOR THE YEAR 1936-37.

Rainfall conditions, floods, damage to works, changes in the course of the river, river training works, condition of upstream and downstream floors of the barrage, repairs to guide banks, and repairs to subsidiary works are briefly described.

HISTORY OF RUPAR HEADWORKS, SIRHIND CANAL FOR THE YEAR 1935-36.

Floods, damage to works, repairs carried out, condition of the river channel, changes in the course of the river, and damage and repairs to river training works are described.

HISTORY OF RUPAR HEADWORKS, SIRHIND CANAL FOR THE YEAR 1936-37.

Contains the same information as the above for the year 1936-37.

INTERIM NOTE ON LINING EXPERIMENTS FOR HAVELI CANAL. Haigh.

This note gives brief details and results of experiments with a view to dertermine the most suitable type of lining for the Haveli Canal, the new project which is under construction in the Punjab. Three types of lining investigated were :—

1. 4″ concrete lining with Sikhanwala ballast aggregate and 1 : 4 cement mortar.

2. Two layers of 12″ × 6″ × 2″ brick tiles with a 3/8 inch joint of 1 : 3 cement mortar.

3. Same as the above with the tiles made from earth treated with sodium carbonate.

The tests were carried out in three tanks constructed on the Lahore Branch. They were situated on the left bank at a high level on spoil so as to obviate any danger of the results being affected by spring level. The tanks were 19′ × 19′ each with concrete walls 1 ft. thick, the percolation through which was considered would be negligible. A 3 ft. depth of water was provided for and the bottom of each tank was fitted with a 2 ft. graded filter sand over ballast on brick drains to ensure the absence of any pressure under the lining. The lining was laid on top of the filter, the edges being embedded in the walls for a distance of 2 inches. Water surface levels were measured by a gauge placed in the tank capable of reading to 0·001 ft. Measurements were made thrice daily at 9 a.m., 6 p.m., and 8 a.m., the water lost being made up between 8 and 9 a.m.

In order to correct for evaporation a metal cylinder of about 18 inches diameter was arranged on brackets inside one tank with its top about 3 inches above the full supply level. The losses in the cylinder were measured daily and taken as representing the evaporation. Water in the tanks was obtained by pumping from the Lahore Branch.

When the tank was first brought into use settlement occurred in the filter resulting in a crack between the walls and the floor. To remedy this a 3″ × 3″ triangular fillet was placed over the joint in all tanks. The results of the experiments are shown graphically, the daily absorption being reduced to cusecs per million square ft. The losses in the case of all the three types of lining decreased with time, rapidly at first and subsequently more slowly. Type 3 gave the best result, the losses decreasing within two months to 0·5 cusecs per million sq. ft. which would correspond with 2 cusecs for million sq. ft. under the 12 ft. head of the canal. The fall in losses may be attributed partly to temperature affecting viscosity but mainly to the pores in the lining becoming tamped with silt. To determine whether the same effect would be produced in running water, arrangements were made to produce a rotary motion of the water in the tanks with a velocity of about 3 ft. per sec. and no appreciable increase in losses was noticed.

The results obtained justified the use of either of the tile linings but were not altogether satisfactory in view of the initial settlement. Various other types of lining were therefore tested in the tanks, each tank being sub-divided into four compartments by cross walls of the same construction as the outer walls, giving twelve tanks. These tanks were not provided with filters but a layer of 2 ft. of sand was placed on the bottom on which the lining to be tested was laid. Altogether twelve types of lining were tested including stone concrete lining of various mixes, brick ballast concrete lining and brick tile linings with ½ inch and ⅜ inch joints in cement and lime mortars. One specimen each of the concrete and brick tile lining was constructed with vents with the idea that the vents would relieve any pressure occurring under the floor when the canal was empty and would be tamped with silt when the canal was running. The results of these experiments are also shown graphically, the best results being obtained with brick tile linings with ½ inch joint of mortar laid as plaster. The next best were the stone concrete linings. The effect of adding 10 per cent. lime to the cement is not very certain, being beneficial in the tile linings but deleterious in the case of concrete linings. The effect of pressure relieving action of the vents is still under investigation. Another point suggested was that the losses would be considerably increased if the subsoil water level were in contact with the underside of the lining and this point will also be further investigated. The brick tile lining with the joint laid as plaster, though satisfactory from the point of view of percolation, is not so good as regards strength owing to the inadequate bond between the upper layer of tiles and the plaster in the joint. Three further specimens were therefore designed with reinforcements consisting of ¼ inch rounds at 2 ft. centres in both directions running through the joints and the tiles. The tiles were specially moulded with grooves for the reinforcements. The joints were ½ inch and ⅜ inch. The results of two of these which have been tested so far are given. The form of lining finally decided upon consists of two layers of 2½″ brick tiles with a ½″ cement mortar plaster of 1 : 2, and reinforcement in between. The lower layer of tiles will be laid on a bed of 1 : 6 cement mortar with 10% lime admixture, and the upper layer will be laid in 1 : 2 cement mortar. Four specimens of this lining will now be constructed and tested.

The analyses of rates for the various types of lining tested are appended to the note.

CHIEF ENGINEER'S ADDRESS ON THE OCCASION OF LAYING THE FOUNDATION STONE OF EMERSON BARRAGE, BY HIS EXCELLENCY SIR HERBERT EMERSON, GOVERNOR OF THE PUNJAB, ON 10TH FEBRUARY 1938.

The Emerson Barrage on the Chenab River just below its junction with the Jhelum River forms the Headworks of the Haveli Canals Project which is under construction in the Punjab. In this address a brief history of the project is given. The objects of the scheme are described outlining the main channels and feeders and the area to be served by them. A brief description of the technical features of the scheme follows. The main object of the scheme is to transfer the waters of the Jhelum and the Chenab into the River near Sidhnai through a feeder canal leading into the Ravi above the existing Sidhnai Weir. The feeder canal on its way will irrigate new areas and the greater portion of the water will be utilized in the irrigation of areas at present served by certain inundation canals which are being linked to the Sidhnai Weir. In addition, a canal will take off on the right bank to irrigate the riverain lands lying between the Thal and the Chenab. The Haveli Canals when fully developed will provide perennial irrigation to more than 500,000 acres and non-perennial irrigation to 450,000 acres. For the supply of water in the Chenab to be held up by this barrage, entire dependance is placed upon regeneration water in the Chenab and Jhelum below the Khanki and Rasul Weirs which are higher up the rivers. The records of discharges at the site of this barrage for the last 15 years show that enough regeneration water is available in both Kharif and Rabi. A feature of the project organization is the Central Designs Office under the personal control of the Chief Engineer where all technical calculations are made and designs prepared for all masonry works on the Project. This is a great improvement on the usual system of each executive engineer in charge of construction divisions preparing his own designs and calculations—a procedure which involved much waste of time and repetition. The Headworks consist of a weir of 37 bays of 60 ft. each with undersluices of 6 bays of 30 ft. each on the right and 8 bays of 30 ft. each on the left. The crest of the undersluices is 5·5 ft. lower than that of the weir bays, the object being to ensure that the deep stream remains close to the canal regulators. In the weir portion there are 3 lines of steel piles and in the undersluices 4 lines, driven to a depth of 20 ft. in the river bed. The floor concrete in which the tops of the piles will be embedded may be imagined as a giant mattress lying on top of the rows of piles. The whole structure will work as one piece, all bound together with steel bars, and with the earth below it completely boxed in by steel piles. Another special feature of the headworks is the provision of silt excluding devices for the complete control of silt. These will be supplemented by silt ejectors on both the canals. The main canal will be lined with brick for a distance of about 45 miles. (*See* also under " Works Section " in this Bulletin.)

Public Works Department (General).

NOTES ON THE YIELD OF WELLS. Punjab P. W. D. Paper No. 63, 1920. **Farrant.**

This paper discusses the various experiments that have been made from time to time to ascertain the yield of wells. Experiments were made at Lahore, Ambala, Amritsar and Ludhiana before the waterworks projects at these places were undertaken. The tests made were of two kinds, namely, pumping tests and recuperation tests. In the former the water level was lowered by pumping to fixed heights and the discharge for the different heights was gauged. In the recuperation tests the water surface was first lowered to different levels and the wells were then allowed to recuperate, the time taken to rise to different levels being recorded. Part I of the paper deals with percolation wells. The theory of recuperation of wells, the rate of flow of water through sand, limiting velocities for the blowing up of sand, critical velocity and discharge in wells, and heads at which blowing is caused in wells are discussed. The tests made on the various wells are briefly described and conclusions drawn are given.

Part II of the paper deals with spring wells in which a sub-artesian supply is tapped. Features of spring wells are described. Limit of head under which a spring well should be worked, relation of size of cavity to discharge drawn from the well, the relation between the diameter of the bore and thickness of foundation clay, stresses in the clay stratum, and the yield of such wells for different heads and diameters of bores are discussed. It is shown that the yield of a spring well is independent of the upper cylinder or casing which need only be large enough to take in the pumping apparatus.

Part III deals with tube wells and some tests made on such a well are described. A comparison of discharges from a 4½ inch tube well and an ordinary percolation well shows that a single tube well would replace three ordinary wells of 12 ft. diameter.

A number of diagrams showing the results of the various tests made are appended.

NOTE ON THE TUBE-WELL PRACTICE OF THE PUBLIC HEALTH CIRCLE, PUNJAB. Punjab P. W. D. Paper No. 82, 1930. — Howell.

This note contains information on tube-wells relating to strainers, boring plant, and pumping plants based on experience in the Punjab. Various types of strainers are described and compared with respect to their merit. The life, yield and initial cost of various strainers are discussed. Conclusions regarding the relation between strainer length and diameter and the yield based on results obtained in the Punjab are given. The effect of wells on subsoil water surface are discussed. Factors governing the selection of suitable pumping plant are mentioned. Different types of pumping plants with their characteristics are described. Initial and operating costs of tube-wells of ½ cusec, 1 cusec, 1½ cusecs and 2 cusecs are compared, and particulars of a number of typical tube-wells constructed by the Department are given.

Irrigation Research Institute, Punjab.

GRAPHICAL DETERMINATION OF EXIT GRADIENT FOR SOME STANDARD TYPES OF STRUCTURES. Research Publication Vol. II, No. 17, October 1936. — Malhotra. McKenzie-Taylor.

Graphical constructions with mathematical proofs are given for the determination of exit gradient in the cases of the following types of structures :—

1. A sheet pile in any position under a horizontal floor.
2. A sheet pile at the downstream end of a horizontal floor.
3. A flush floor.
4. A depressed floor.
5. A floor with equal piles at heel and toe.
6. Single pile in equal filling.

UPLIFT PRESSURES UNDER A SLOPING FLOOR. Research Publication Vol. II, No. 18, October 1936. — Malhotra. McKenzie-Taylor.

This paper deals with investigation of subsoil flow under a sloping floor whose top and bottom are at the same levels as the upstream and downstream horizontal layers of sand, such as a canal rapid or a fall with sloping glacis. The equations of subsoil flow have been obtained and the uplift pressures at various points under the sloping floor have been worked out. An expression for the rate of change of pressure along the floor is also derived.

GRAPHICAL METHODS FOR THE DETERMINATION OF PRESSURE DISTRIBUTIONS UNDER SOME STANDARD FORMS OF IRRIGATION WORKS. Research Publication Vol. II, No. 21, October 1936. — Malhotra. McKenzie-Taylor.

Graphical methods are given for the determination of uplift pressures at various points in the following cases of construction:

1. A sheet pile in any position under a flush floor.
2. A sheet pile at the toe of a flush floor.
3. Flush floors.
4. Depressed floors.
5. A floor with equal end piles.
6. A single pile in equal filling.

The mathematical proof of the construction employed in each case is given.

NOTES ON KHOSLA'S PRINCIPLE OF INDEPENDENT VARIABLES IN ITS RELATION TO THE DESIGN OF WEIRS II. PRESSURE DISTRIBUTION UNDER A FLOOR HAVING EQUAL END PILES AND A VARYING INTERMEDIATE PILE. Research Publication Vol. II, No. 22, October 1936.

Malhotra.
McKenzie-Taylor.

In this paper, the pressure distribution under a flush floor with two equal end piles each one-sixth the length of the floor and an intermediate pile varying in length and position is investigated by fitting an empirical formula to the values obtained experimentally for the percentage pressures at the joints of the inner piles with the floor. The formula developed gives a very good fit in all cases. This new formula is justified and extended for all values of end pile-floor ratio by developing the case where end piles do not exist. Rules of design are given for obtaining the uplift pressures at the four key points of the distribution, namely, the points at which the piles join the floor. The rules are illustrated by examples.

SOIL DETERIORATION IN THE CANAL IRRIGATED AREAS OF THE PUNJAB. PART III—FORMATION AND CHARACTERISTICS OF SOIL PROFILES IN ALKALINE ALLUVIUM OF THE PUNJAB. Research Publication Vol. IV, No. 9.

Puri.
McKenzie-Taylor.
Asghar.

Results of analyses of a number of typical soil profiles in the alkaline alluvium of the Punjab are given, and the characteristics of the soil constants in the profiles are discussed. The influence of prolonged cultivation in modifying the profiles is also discussed. It is concluded that the morphological characteristics of alkaline soils in the Punjab are not sufficiently defined to form the basis of soil classification and physico-chemical analyses are more suitable. The formation of *kankar* layer in alkaline soils is discussed.

A NEW METHOD OF DETERMINING SEEPAGE FROM CANALS IN AREAS OF HIGH WATER-TABLE. Research Publication Vol. V, No. 7, August 1937.

Midha.
Luthra.
Vaidhianathan.

This paper describes a new method of determining the seepage from a canal situated in an area where the water-table is not far below the natural surface. It is not applicable when the water-table is below 12 ft. and presupposes a saturated connection between the bed of the canal and the water-table. The method depends upon the determination of the angle ⓤ which the outermost streamline of subsoil flow makes with the vertical and the measurement of the velocity v of the subsoil flow by an electrical method. The total flow across any section of a canal can then be obtained by the integration of a mathematical expression involving the two variables H and v. The theory of the mathematical procedure is given.

REPORT OF THE PUNJAB IRRIGATION RESEARCH INSTITUTE FOR THE YEAR ENDING APRIL 1937.

This report describes the work carried out in the various sections of the Institute during the year. The important investigations carried out are as follows :

Chemical Section.

1. Movement of moisture and salts in soils.
2. The rise of water-table with reference to the nature of soil profiles.
3. Staunching of canals by the use of sodium carbonate.
4. Studies in soil mechanics, measurement of cohesion and erosion.
5. The use of hygroscopic substances in preventing soil movement—stabilization of earth roads with sodium and calcium salts.
6. Standardization of methods, new methods and apparatus adopted for moisture estimation in soils, estimation of salinity of soils and waters, and estimation of humus in soils.

Physics Section.

1. Uplift pressure on weirs, with sheet piles in different positions, graphical solutions and model experiments.
2. Examination of models of existing weirs. Examination of Sidhnai Weir model, and model experiments with proposed Kalabagh weir of the Thal Project.
3. Developing an apparatus for the determination of cavities below weirs by the wireless method.
4. Determination of seepage in the Jhang and Rakh Branches.
5. Experiments with models to study the laws of seepage in saturated flow.
6. Transmission constant of soils.
7. Angle of repose of drains.
8. Stress distribution under foundations.
9. Silt analysis for the study of regime conditions and silt investigations.

Mathematical Section.

1. The problem of sub-soil flow in weirs on sand foundations.
2. Problems of flow in open channels ; effect of temperature and silt on discharge measurements by current meter and by a rectangular weir.

3. Problems of silt movement and design of channels; effect of temperature on the silt diameter variation, and mix of silt samples.

Statistical Section.

1. Relation between rainfall and run-off in the upper Ravi River Catchment; investigation of the effect of the alleged denudation of the foothills on the increase in number and intensity of the floods in the river.
2. Statistical examination of seepage losses in a five mile reach of Jhang Branch, Lower Chenab Canal.
3. Survey of some *thur* stricken villages in Sheikhupura District.
4. Silt movement as applied to design of regime channels.
5. Analyses of silt entering canals under varying conditions of supply and regulation.
6. Run-off and soil erosion in relation to plant cover.
7. Analysis of pressure pipe observations recorded at Islam Weir.
8. Soil hardness—effect of sodium carbonate treatment.
9. Soil deterioration experiments.
10. Investigations of subsoil flow under irrigation structures; general theory of hydraulic pressure gradients under structures of various types; uplift pressures under a sloping floor; mutual interference o equal piles at ends of a floor; efficiency of a pile line under a floor, graphical methods of determining exit gradients.

Hydraulic Section.

1. Investigations of models of works in the flume in the laboratory at Lahore and the research station at Malikpur.
2. Model experiments for protections below Ferozepur Weir, and Islam Weir.
3. Model experiments with Merala Weir for reconditioning the weir.
4. Investigations with models of proposed Trimmu Weir, Haveli Project.
5. Model experiments with certain falls to reduce downstream scour.
6. Investigations of Sutlej River above Islam weir.
7. A new method for demonstrating the flow of water under models of works.
8. Silt investigations on the Upper Bari Doab Canal.
9. Shingle movement in the Upper Bari Doab Canal, model experiments at Malikpur.

Land Reclamation Section.

1. Reclamation of *Thur* land.
2. Prevention of Land Deterioration.
3. Soil Surveys of *Thur* land.
4. Effect of irrigation on land deterioration.
5. Distribution of salts and moisture in the soil profile under irrigation in areas with a low water-table.
6. Soil erosion and run-off.
7. Rise of water-table in Rechna Doab.

General Section.

1. Examination of water and soil samples.
2. Chemical analysis of silts of the Punjab Rivers.
3. Studies in the electrodialysis of soils.
4. Study of soils in the hill areas of Kashmir.

Forest Department.

IRRIGATED PLANTATIONS IN THE PUNJAB. A MANUAL OF ALL OPERATIONS. **Bahadur Singh.**

This book deals with the formation of plantations, and the technique of afforestation and irrigation as applied to it. It is based on experience and observations made on different plantations in the past and contains standard instructions for the guidance of plantation officers in the Forest Department. It describes lay-out of plantations, methods of afforestation, methods and control of irrigation, tending of plantation crops, and other practical information relating to plantations.

GENERAL CATALOGUE OF PUNJAB GOVERNMENT PUBLICATIONS CORRECTED UP TO 1ST APRIL 1937, WITH MONTHLY SUPPLEMENTS FROM MAY 1937 TO FEBRUARY 1938.

BOMBAY.

Public Works Department (Irrigation Branch).

LAND DRAINAGE IN THE DECCAN CANAL AREAS. Technical Paper No. 56, 1937. (Prefatory Note by Mr. C. C. Inglis, C.I.E.). **Evershed.**

A special Irrigation Division was opened in 1916 to investigate how to drain successfully the irrigated lands commanded by the Deccan

Canals. A number of Technical Papers dealing with soil and subsoil surveys, the methods of improving damaged land in the canal irrigated tracts in Bombay Deccan, and experiments on land drainage at Baramati, have since been published. The present paper records all the experience with this drainage work that has been obtained up to date and co-ordinates the results of eighteen years research and experience in the laboratory and in the field. The paper is divided into four parts. Part I deals with soils and sub-soils. Characteristics of the rocks and soils of the Deccan are described, and properties of the soil such as texture, permeability, soil moisture, etc., are discussed. It is explained how damage frequently occurs in a Deccan valley and data from an actual example from the Baramati Salt Area are given as an illustration. Factors leading to the rise of sub-soil water are discussed and factors which help in controlling the water-table are analysed. Movement of subsoil water has been studied and the rates of flow arrived at from some experiments are tabulated. Results of subsoil drainage on the water-table, and the physical condition of the soil are described, together with means adopted to restore the fertility of the soil after drainage. The advantages of drainage are mentioned. It is abundantly borne out by the data on record that drainage in the initial state of damage, that is, as soon as the subsoil water-level rises to within 4 ft. of the ground level would entail no expenditure on reclamation, and the land would still remain fit for cultivation. The considerations which are necessary to formulate an order of urgency for drainage schemes and the various factors which are to be co-ordinated in designing drainage schemes are discussed.

Part II of the paper deals with general principles of preparation of a drainage project. Subsoil surveys, surveys of damage, and subsoil water level surveys are the first works to be carried out and the general procedure based on experience in a number of schemes is described. Special points to be taken care of in soil damage survey and subsoil survey are discussed in detail, and in the case of the latter the use of augers of various types is explained. The method of plotting the data from the subsoil survey is described. The principles of design and alignment of drains for different conditions are set forth in detail and a number of typical cross sections are shown. The method of treatment of road crossings is given, with some standard designs. Other works such as inlet for cross drainages, falls, aqueducts siphons are briefly described. Design of pipe drains is treated in detail and discharge curves for pipes of different diameters with different slopes are given. Subsidiary works for pipe drains are described. Instructions as to submission of projects together with a list of drawings for a complete project are given. Details instructions are given for the completion of the various drawings, and plans are also given.

Part III of the paper deals with construction of drains. The procedures of land acquisition and preliminary work before the actual construction are described. Instructions for observations to be recorded previous to and during construction, specifications for open pipe and rubble drains, site clearance, setting out curves, service roads, spoil banks are given.

Part IV deals with the maintenance of drains. Important points to be observed in the maintenance of open drains include the grassing of slopes, and various types of grass found suitable are described. Permission for grazing should not be given on a drain. Treatment of slips, repairs to service road, and planting of trees are dealt with. Maintenance of pipe drains is also discussed.

COMPLETION REPORT OF THE PRAVARA RIVER WORKS PROJECT.

This report contains a descriptive account of the Lake Arthur Hill (Wilson) Dam at Bhandardara and of the Pravara Right and Left Bank Canals, with statements of expenditure and financial forecasts. A history of the project is given in the course of which the reason for deciding upon a dam of great height in the Pravara Valley, considerations leading to the selection of the Bhandardara site in preference to other sites investigated, and comparative costs at various heights, are discussed. A general description of the project works follows. The dam is 270 ft. high and is of gravity type, constructed in uncoursed rubble masonry in hydraulic lime mortar. Main features of construction are described. The first project was sanctioned in 1907 and subsequently revised in 1915. Reasons which necessitated the revision of the project are discussed. During construction a crack was discovered in the foundation of the dam on the right bank. The method of treating the crack which consisted essentially of grouting with one to three cement mortar is described. Dimensions and hydraulic data of the dam are given in an appendix. The Pravara Canals are then described. The headworks comprise a pick up weir and regulators for the canal heads on the right and left banks. Details of the weir are given. The right and left bank canals are then described giving the main features of alignment, the areas commanded, the cross sections of the canals and works on the canals. A description of the distributary system follows. Schedules showing details of costs of the various works with savings and excesses over the sanctioned estimate and financial forecast statements are given in the appendix.

APPENDICES II AND III TO THE NEW BHATGAR DAM REVISED PROJECT.

These give the calculations for the stability of the Bhatgar Dam, and calculations for the subsidiary weirs.

* BOMBAY PUBLIC WORKS DEPARTMENT MANUAL.

This manual contains the administrative and executive rules of the Public Works Department of Bombay, and also extracts relating to the Department from other Government Publications. It is divided into eight parts as below :—

I.—Administrative and Executive Rules.
II.—Extract from the Fundamental Rules.
III.—Financial Rules.
IV.—Extract from Treasury Orders.
V.—Extract from Auditor General's Rules.
VI.—Extract from Audit Instructions.
VII.—Power of Sanction.
VIII.—Rules relating to Central Works.

SUPPLEMENT TO THE BOMBAY PUBLIC WORKS DEPARTMENT MANUAL.

This Supplement contains rules governing the submission of estimates for construction of irrigation works, the cost of which exceeds the powers of sanction of Provincial Governments.

Department of Agriculture.

ALKALI OR KALAR EXPERIMEMTS AND COMPLETION REPORT OF THE DAULATPUR RECLAMATION STATION, SIND. Bulletin No. 64 of 1914. Henderson.

This Bulletin reports the results of experiments on the reclamation of alkali soil carried out in Sind during the period 1907 to 1914. The formation of alkali soils is described and different types of alkali soils with their characteristics are discussed. The principles underlying reclamation of alkali soils are described and American and Egyptian practices are referred to. Alkali conditions in Sind are then discussed together with climatic conditions and irrigation practice in the province at the time of the reclamation experiments. These experiments were carried out at Mirpurkhas, Daulatpur and Sukkur. The subsoil water level at these places was 18 to 20 ft. deep. Results of experiments at Mirpurkhas and Sukkur are given in brief. The Daulatpur experiments which were continued over a long period, are described in detail. The analyses of soils at Daulatpur are given and the preliminary works constructed which include a minor and a drainage outlet are described. The cropping system adopted is then described and the cost and return obtained are given. In discussing the results of the experiments the author says—"If the Sukkur Barrage or any new perennial canal were constructed a higher percentage of irrigation would be necessary to make the scheme pay. To get this higher percentage it would not be possible to simply cut out the fallows. With more intensive cultivation rotation crops must be included and for this purpose berseem here as in Egypt has proved itself to be not only the best but the only suitable leguminous rotation crop ".

WELL WATERS FROM THE TRAP AREA OF WESTERN INDIA. Bulletin No. 74 of 1915. Mann.

In this bulletin the author presents results of chemical analyses of samples of water from a large number of wells located at different places in the Deccan Trap Area. In the introduction the author discusses important features of wells in the Deccan trap. He gives actual figures obtained for the analyses of a number of well waters from various parts of the Trap Area and discusses the results obtained. These analyses disclose some common general characters of the well waters in the Area, which are set forth. The author also investigated for over six years the question as to what extent the character and quantity of the salts vary at different times of the year in the same well. For this purpose he conducted monthly analyses of waters from a number of selected wells from Dhulia in Khandesh, Surat and Dharwar. The results obtained and conclusions are given.

INVESTIGATIONS INTO THE NATURE OF THE SALT LANDS OF SIND. Bulletin No. 96 of 1920. Tamhane·

This bulletin describes investigations of the conditions of salt formation and accumulation in Sind with a view to ascertain the danger of extensive salt development in that province on the introduction of perennial irrigation by the Sukkur Barrage Canals. An analysis of three types of kalar met with in Sind shows that chlorides are the main constituents and sodium carbonate is not necessarily a constituent. The danger of the formation of sodium carbonate in the soil by the use of river water is remote because an analysis of Indus water shows that it does not contain sodium carbonate. Sodium and calcium chloride are not so injurious to plants as sodium carbonate. Investigations of soil conditions in the proposed right and left bank canal areas are described and the conclusions drawn are given. The problem of waterlogging was investigated in an area on the Jamrao canal which was a perennial canal opened in 1899 and it was found that the subsoil water level was not near enough to allow its rise by capillary action with consequent salt formation. Comparison is made between the existing and the probable future conditions of agriculture in Sind, and steps to be taken in the future to rectify present injurious practices are indicated. The Hiral tract was also investigated because it is one of those tracts where damage has been done by perennial irrigation but the main cause of damage is said to be the bad alignment of the Hiral canal. The results of the investigations are summarised at the end, the main conclusions being that irrigation is safe on the right bank canal tract while on the left bank it will probably lead to a greater increase of kalar unless drainage is also undertaken.

AGRICULTURE IN SIND UNDER THE BARRAGE CANALS SYSTEM Bulletin No. 159 of 1929. Main.

This bulletin contains a series of articles describing the fundamental changes which were expected to take place in agricultural practices in Sind on the introduction of irrigation from the Lloyd Barrage Canals, and the preparations made by the Department of Agriculture to assist the public in developing the country on the best lines. Maintenance of soil fertility, kalar formation and the danger of waterlogging are dealt with in particular. The need for agricultural research is emphasized and the work at the Sakrand Agricultural Station is described in detail in this connection. Other subjects dealt with are, the prospects of mechanical cultivation in Sind, some aspect of the rice problem, possibilities of certain kharif leguminous oil-seeds for export, and control of the rat pest. The agricultural propaganda carried out by the Department is also described.

STUDY IN INTENSIVE FARMING NEAR POONA, UNDER CANAL IRRIGATION. Bulletin No. 164 of 1930. Patel. Desai.

This bulletin describes the experimental work carried out at the Poona Agricultural College Farm on the best way of growing different vegetable crops. Study was also made of the costs of production, marketing the vegetables and the profits obtained with a view to investigate the possibility of introducing business methods in farming. The results obtained are given.

CATALOGUE OF PUBLICATIONS OF GOVERNMENT OF BOMBAY NO. 11 CORRECTED UP TO 31ST DECEMBER 1936, TOGETHER WITH LIST OF NEW BOOKS FOR JANUARY 1937 TO JANUARY 1938.

SIND.

Public Works Department (Irrigation).

REPORT ON EXPERIMENTS WITH A MODEL OF A CROSS REGULATOR OVER GHAR BRANCH R. D. 34150, CARRIED OUT IN THE DEVELOPMENT AND RESEARCH DIVISION AT THE KARACHI TESTING STATION. Technical Paper No. 3. Bushby. Hiranandani.

A cross regulator was proposed on Ghar Branch *ex*-Rice Canal capable of passing a discharge of 2,977 cusecs. Model experiments were carried out to determine the minimum length and the kind of protection required which would give satisfactory conditions of flow on the downstream side. These experiments are described herein. A model 1/18th the full size was constructed with sides of 4 inches brick masonry in cement. The bed sides and pitching were covered with cement plaster and an earthen channel was constructed immediately below the end of downstream expansion to study the effect of disturbance. Total number of tests performed was 162 of which details of 10 experiments with various types of protection are given. One of these experiments was carried out with a flume on the downstream side designed according to the method given in Central Board of Irrigation Publication No. 6. Other experiments were carried out with deflectors, baffles, staggered blocks, vanes, etc., in different positions, in addition to vertical walls on the downstream side with divergence in accordance with the design given in Central Board of Irrigation Publication No. 6. Finally a design with vertical returns with a baffle on the glacis was found to be the most suitable and was recommended for adoption in the prototype.

REPORT ON THE HEADWORKS AT SUKKUR, 1937-38 (PERIOD 15TH MAY 1937 TO 15TH OCTOBER 1937.)

This report describes monsoon and flood conditions at the Headworks, silt conditions, regulation, damages, and other operations. The strongest current was on the left bank side. The largest amount of silt carried was during the period 16th June to 15th July. The silt bars formed at the entrance to approach channels are increasing in height in successive years thereby preventing the exclusion of heavier silt from the canals. The depth of silt in the right bank approach channel has reached a stage where mechanical means must be resorted to to remove it if it is desired to use the approach channel as a pocket for trapping silt. On the Barrage, it was found that the Right Bank pocket near the scouring sluices gates had silted up and the gates could not be lifted up by the motors and by jetting. The operation of the central crab winches by hand power was resorted to resulting in shafts and gears in three gates developing twists and cracks due to the extra strain. Minor repairs were effected. A statement of soundings above the barrage is attached. Other statements showing upstream pond level of the river and downstream level, fortnightly average silt content of the water in the approach channels and the canals, and the opening of scouring sluices are also attached.

MADRAS.

Public Works Department (Irrigation).

INLAND WATERWAYS IN THE MADRAS PRESIDENCY, 1935.

"This manual contains a description of the inland waterways in the Madras Presidency and the facilities they offer for trade. It gives among other things an idea of the tonnage of boats plying on the several canals, their maximum drafts when loaded, the depths of water in the canals, the reaches of rivers which are navigable, the connection with the adjacent canal systems and the places where locks exist on the canals, with their dimensions ".

MASONRY DAM ACROSS THE KOTHAYAR AT PACHIPARA: DESIGN OF THE PROFILE BY MOLESWORTH'S EMPIRICAL FORMULÆ AND PROCESS IN THE DESIGN.

Calculations for the design of the dam and stress diagram of the dam are given.

MADRAS PUBLIC WORKS DEPARTMENT CODE WITH APPENDICES, 1935.

" The Code is intended to define the scope of administrative and executive functions of the officers of the Public Works Department ".

Department of Hydro-Electric Development.

ADMINISTRATION REPORT FOR THE YEAR 1929-30.

Brief details of the principal works under construction namely the Glen Morgan Hydro-Electric Scheme and the Pykara Hydro-Electric scheme, are given and investigations on a few other schemes including the Periyar and Papanasam Schemes are described. Programme of work for the ensuing year is given.

ADMINISTRATION REPORT FOR THE YEAR 1930-31.

The activities of the department, progress in the Pykara construction works, operation of the completed Glen Morgan Scheme, the work done on the Mettur scheme, investigations of other possible power sites, power demand surveys conducted, and hydrometric studies made are dealt with in this report.

Department of Agriculture.

REPORT ON THE SOIL SURVEY OF THE TUNGABHADRA PROJECT, 1937. Venkataramiah.

The proposed Tungabhadra Project aims at the utilization of the waters of the Tungabhadra River for the irrigation of the Ceded Districts of Madras Presidency, namely, Bellary, Anaulpur, and Kurnool. These districts are situated between the Eastern and Western Ghats and have a low and precarious rainfall and are subject to famines. The soils are generally of high fertility and possess high moisture retention properties. Black soils form a large percentage of the total area to be commanded by the Project. The scheme consists of a dam on the Tungabhadra with a storage capacity of 120,000 million cu. ft. and a waterspread of 138 square miles. A main canal will take off from the reservoir and will traverse through the area with a system of distributaries. The command proposed has an area of 1,072,500 acres. While the utility of any irrigation scheme to confer immunity from famines in the area in question has never been doubted, the suitability of black soils for irrigation has frequently been questioned. The black soils of Bombay Deccan were irrigated under the Nira Valley Canals and alkalinity developed on a large scale as a result of irrigation. A detailed examination of the question of irrigability of black soils was considered necessary in the case of the Tungabhadra Project and a soil survey by the Agricultural Department was sanctioned by the Government in 1934. This report gives the results of the survey. Previous soil surveys of the Delta tracts in the Madras Presidency were mainly to determine the status of fertility of the soils. The present survey is essentially different, its purpose being to determine the suitability for irrigation. In such a survey it is necessary to study the physical properties of the soils in horizons, down to a depth of 6 ft. the maximum depth to which irrigation water is likely to penetrate. A study of soil reaction and soluble salt content is also necessary. Details of the soil survey were drawn up in accordance with the above consideration and are briefly summarized as below :—

1. Study of the various types of soils in the area with a view to arrive at an approximate classification of soil types.
2. Study of physical properties such as structure and texture at the different horizons of the profile and the relation of these properties to permeability and capacity for drainage.
3. Determination of the occurrence and quantities of soluble salts present in the different horizons of the profile.
4. Study of the probable effects of irrigation with special reference to accumulation of soluble salts and waterlogging.
5. Determination of the type of irrigation, that is, light, medium or heavy, suitable for the area.
6. Suggestion of drainage and reclamation measures likely to crop up on the advent of irrigation.

A description of the area commanded by the project is given, and conditions of drainage, rainfall, erosion, geology, hydrology, and agriculture are briefly stated. The field work in the survey operations is then described. One profile pit was dug for each four square mile block all over the area, which was approximately 1,600 sq. miles. The pits were excavated to bedrock, or water-table or less, but not exceeding 8 ft. The profiles were then studied. The laboratory work consisted of examination of over 400 type samples from the area. The main laboratory determinations consisted of (1) the determination of soluble salts by the electrical conductivity method, (2) mechanical analysis by the International method, (3) Hygroscopic coefficient, (4) maximum water holding capacity, (5) pore space, (6) absolute specific gravity, (7) amount and nature of water soluble salts, (8) percolation and permeability, (9) exchangeable bases and degree of alkalisation, (10) total nitrogen, (11) total and available phosphoric acid, (12) hydrogen-ion concentration, (13) carbon-di-oxide, (14) initial and 7 days' increase in specific conductivity.

The classification arrived at from profile studies is given, and the characteristics of each class are discussed. The geological theory of the formations is discussed, and a theory to explain the origin of black soils is put forward. The results obtained from laboratory investigations as described above are discussed for dry and for wet soil samples. Analysis of the Tungabhadra River water at the site of the proposed dam was also carried out to assess the effect of the water on the soil, and results are given. Conclusions from the survey are discussed at length and it is stated that there is no evidence to show that any ill effects such as water-logging or increase of alkalinity will follow the introduction of irrigation provided proper safeguards are adopted for a judicious application of water, and introduction of drainage measures to implement the natural drainage of the country.

Based on the field and analytical data obtained, a number of recommendations are made which include provision of proper drainage as an adjunct to the irrigation project, a strict system of irrigation to obviate indiscriminate use of water and the establishment of an irrigation research station for the study of soils under irrigation. A number of maps and tables showing the results of the survey are appended.

REPORT ON THE OPERATIONS OF THE DEPARTMENT OF AGRICULTURE, MADRAS PRESIDENCY, FOR THE YEAR 1936-37.

A report of the activities of the Department is given herein. Research work included soil surveys of the Cauvery-Mettur Project area, and investigation of the origin of the black and red soils in the Tungabhadra project area. The effect of sullage water on paddy was investigated, and it was found that undiluted effluent has a deleterious effect on the growth of seedlings in their early stages but later on it helps to improve the tillering capacity of the plants thereby increasing the yield. Experimental work with various crops is described. Details are given of the demonstration and propaganda work carried out.

A SOIL SURVEY OF THE KISTNA DELTA.
Vol. IV—Bulletin No. 75, 1918.

Harrison.
Ramaswami.
Viswanath.

This survey was carried out on similar lines to that of the Tanjore Delta. Analyses of a number of representative soil samples collected in the course of a detailed tour of inspection in the area were made and the quantities of lime, magnesia, nitrogen, phosphoric acid and potash were estimated. The distribution of these components in the delta soil is shown by a number of maps. General conclusions from the survey are given.

A SOIL SURVEY OF THE TANJORE DELTA. Harrison.
VOL. III—Bulletin No. 68, 1921. Ayyangar.

The soil survey was carried out with the object of obtaining some knowledge of the general manurial requirements of the Delta. The work included a detailed tour of inspection of the area in the course of which over 134 representative soil samples were collected for analysis in the laboratory. The analysis was confined to the estimation of the total and available phosphoric acid, potash and nitrogen, lime and magnesia. The procedure of analysis is briefly described. A number of maps of the Delta showing diagrammatically the distribution of the various chemical constituents mentioned above in the soil are included with explanatory notes. A table showing the analytical results in extenso is given.

A SOIL SURVEY OF THE GODAVARI DELTA. Norris.
Bulletin No. 83, 1922. Viswanath.
Ayyar.

Results of the soil survey of the Godavari Delta are given herein. From this area 69 soil samples were collected from typical fields under paddy cultivation and analysed. The object of the survey being limited to ascertaining approximately the present manurial requirements of the paddy areas of the tract, the analyses were limited to the estimation of nitrogen, phospheric acid, potash, lime and magnesia.

A SOIL SURVEY OF THE PERIYAR TRACT. Norris.
- Bulletin No. 84, 1923. Sivan.
Ayyar.

Results of soil survey of the tract irrigated by the Periyar Irrigation System are given in this bulletin. The tract lies on the left bank of the river Vaigai and differs essentially in characteristics from the Delta areas in which previous soil surveys were carried out. The survey was carried out on lines similar to those in the case of the Delta areas and the analyses were confined to the estimation of nitrogen, potash, phosphoric acid, lime and magnesia. The distribution of these over the area is shown by a number of maps.

THE VILLAGERS' CALENDAR, 1938.

This annual publication is a compendium of useful information for the agriculturist in the Madras Presidency. It gives information about the various circles of Agriculture in the Presidency, names of demonstration centres in the Circles, list of depots for seeds, implements and manures, and names of research stations with brief details of the work carried out. Short notes on agricultural subjects are included and deal with care and repair of implements and tools, principles of plant disease control, how to destroy unwanted trees, insect pests and their control, fungus diseases, and instructions for sending soil samples for analysis. The publication also contains information on livestock breeding and management, the veterinary department, fisheries, public health, co-operative societies, and industrial institutes in the Presidency. A list of publications of the Department is given. A vernacular edition of this publication is also available.

A NOTE-BOOK OF AGRICULTURAL FACTS AND FIGURES, 1928. Wood.

This notebook contains useful information on agriculture and allied subjects in a concise form, very convenient for handy reference. The subjects covered include weights and measures, elementary mensuration and surveying rules, water lifting machinery, duty of water, gauging of water by weirs, labour required in various agricultural operations, soils and soil analysis, manures, crops, nutritive value of various food crops, insect pests and diseases of plants, livestock and dairying, horticulture, and timber trees. Several useful tables are given and a statement showing the average yield of principal crops in Madras is also given.

Department of Industries.

THE MANUFACTURE OF SODIUM CARBONATE FROM THE ALKALINE SOILS ("PSOUDU") OF THE MADRAS PRESIDENCY. Bulletin No. 5—New Series, 1923. Marsden.

The possibility of manufacturing sodium carbonate from alkaline soils in the Madras Presidency and certain investigations relating thereto are discussed in this paper.

ARTESIAN SPRINGS TAPPED BY THE INDUSTRIES DEPARTMENT. Bulletin No. 34, 1932. Pillai.

The chief function of the Industrial Engineering Branch in Madras is tapping of subsoil water for the benefit of agriculturists and occasionally for drinking water supply. Numerous boreholes have been put down all over the Presidency and include 42 artesian springs in the northern and southern portions of the Presidency. Statistics relating to these artesian springs are given in this bulletin. In the introductory remarks the Compiler discusses the problem of conservation of artesian water supplies which very often run to waste as is shown by the statistical statement of the artesian springs.

PUMPING PLANTS OF SMALL POWER. Bulletin No. 35, 1934. Pinto.

This pamphlet contains information on the consumption, capacity and cost of maintenance of kerosene and crude oil engines of small power for lifting water, pumps of various types, electrically driven pumps, instructions on the installation of pumps, common troubles in pumping plants and their remedies, and general instructions on the purchase and installation of pumping machinery of small power for irrigating small holdings. Details of tests of a number of pumping plants carried out in the Departmental workshops are given.

RESULTS OF BORING OPERATIONS CARRIED ON DURING 1928-29.

Data relating to depth, strata encountered, yield of water and quality of water, are given for a large number of borings carried out in various districts of the Madras Presidency during 1928-29. A few borings to ascertain the nature of the subsoil for bridge foundations are also included.

PROGRESS IN IRRIGATION BY PUMPING IN MADRAS. Chatterton.

This is a paper contributed to the Industrial Conference held at Allahabad in December 1910 and describes the progress made in the Madras Presidency in the development of pumping water for irrigation. The probable area irrigated by pumping is estimated to be about 12,000 acres and the capital outlay on the pumping schemes comes to Rs. 7 lakhs. The Divi pumping scheme is not included in the above figures, being a major irrigation work. The author also discusses the directions in which progress on the engineering side of the question is likely to facilitate extensions in irrigation by pumping.

Legal Department.

MADRAS ACT NO. V OF 1934.

An act to provide for the preservation in efficient condition of tanks belonging to landholders which are used as part of the Periyar system of irrigation in Madras Presidency was passed by the Legislative Council of Madras in 1934. Provisions of this act are given with examples of its operation in specific cases.

MADRAS ACT NO. XXII OF 1936.

This act to amend the Madras Rivers Conservancy Act, 1884, was passed by the Legislative Council of Madras in 1936.

NOTIFICATIONS AND NAVIGATION RULES UNDER THE CANALS AND PUBLIC FERRIES ACT, 1890, EAST COAST CANALS, CORRECTED UP TO 31ST JULY 1933.

Rules regarding licences, registration and plying of vessels on certain canals in the Madras Presidency are given herein

MADRAS COLLEGE OF ENGINEERING MANUAL— IRRIGATION, 1931. **Ellis.**

This is a text book on irrigation for the use of students of the Madras Engineering College, and its scope is confined to flow irrigation as practised in South India. There are 15 chapters covering about 400 pages dealing with all aspects of irrigation. Chapter I is confined to definitions and general remarks on irrigation as practised in the Madras Presidency. Chapter II deals with water supplies required for irrigation. The significance of the term " duty of water " is explained and the duty of rice which is the most important crop in South India is discussed in detail. Transplantation of rice is dealt with and the water required by rice after transplantation is given. Chapter III deals with water supplies available for irrigation. Rainfall is the source of all supplies for irrigation. Variation of rainfall over an area, and estimate of average rainfall over an area are discussed. Methods of measuring rainfall are described. Run-off is defined and the factors affecting run-off are discussed. The relation between rainfall and run-off is considered and methods of measuring stream flow are described. Ryves' and Dickens' formulæ for computing maximum flood discharge which are generally used in South India are given and considerations for the selection of suitable coefficients for these formulæ are discussed. Chapter IV deals with percolation and evaporation, from, catchment areas, permeability of soils, saturation gradient, velocity of percolation through sand, percolation under foundations, percolation through embankments, upward pressure on works from subsoil percolation, evaporation losses from tanks, and evaporation and absorption losses in canals. The problems of silt and scour are discussed in Chapter V. Factors influencing the nature and quantity of river silt, measurement of quantity of silt, the Punjab system of silt analysis, quantities of silt carried to the sea by large rivers, alluvial formations and delta formation, silting of tanks, characteristics of deltas and deltaic rivers, Kennedy's theory of critical velocities and silt transportation, silting of canals, nature of scour, and erosion by clear water are some of the subjects dealt with in this chapter.

Chapter VI contains a general description of canal headworks with subsidiary structures, under two sections, diversion works, and storage works. Chapter VII deals with the design of masonry dams of the gravity, arched and buttress types. Stability diagrams for dams, calculation of stresses and analyses of dams in general are given. Some examples of actual dams are discussed. The design of river weirs and subsidiary works is dealt with in Chapter VIII, and stability diagrams of weirs are discussed. Cross sections of a number of actual weirs are shown, and the design of weirs on sand foundation is treated in some detail. Chapter IX deals with regulators at headworks, scouring sluices and head sluices. Earthen dams and overflow works for reservoirs are treated in Chapter X. Chapters XI, XII and XIII describe distribution works, such as canals and distributaries, masonry works on canals, cross drainage works, and drains. Chapter XIV is devoted to navigation works in canals including locks and sluices and the design. of navigation canals in general. The last chapter describes various types of regulating gates and shutters used in irrigation works.

CATALOGUE OF GOVERNMENT PUBLICATIONS ON SALE AT THE GOVERNMENT PRESS, MADRAS, CORRECTED UP TO 30TH JUNE 1937.

BURMA.

Public Works Department (Irrigation Branch).

ADMINISTRATION REPORT OF THE PUBLIC WORKS DEPARTMENT, BURMA (IRRIGATION BRANCH) FOR THE YEAR 1936-37.

This report is a general review of financial results of irrigation works, weather conditions, flood conditions, and progress of construction works during the year 1936-37. Statistical statements of financial results, areas irrigated, navigation results, working expenses, and assessed water revenue, etc., are included.

Department of Agriculture.

REPORT OF THE AGRICULTURAL STATIONS FOR THE YEAR ENDED THE 31ST MARCH 1937.

The work carried out at the agricultural stations in Burma is described. The principal investigations concerned paddy, and experiments on the yield, fertilizer experiments, work on breeding improved strains, transplanting and broadcasting experiments, cultural experiments, compost making, etc., are described.

CATALOGUE OF PUBLICATIONS, GOVERNMENT OF BURMA, CORRECTED UP TO 1ST JANUARY 1938.

CANADA.

Department of Mines and Resources.

HYDROELECTRIC PROGRESS IN CANADA IN 1937.

This is an annual review of the progress of hydroelectric works in Canada describing the activities in hydroelectric development by provinces.

UNITED STATES OF AMERICA.

Department of the Interior, Bureau of Reclamation.

A METHOD OF DETERMINING THE BACKWATER AT BRIDGES FOR STREAMING FLOW. Translated by Messrs. D. P. Barnes and Edward F. Wilsey, from a pamphlet published to celebrate the dedication of the new building of the Division of Engineering Structures of the Technical Univeristy of Karlsruhe, November 26, 1921. Rehbock.

This is a translation from the original in German made for the U. S. Bureau of Reclamation. Investigations on streaming flow at bridge piers carried out by models are described in the paper. Backwater due to bridge piers has also been investigated. A series of tests which included more than one hundred different pier forms was undertaken in the old river laboratories of the Karlsruhe Technical University. It has been possible to derive from these experiments a general procedure for determining the backwater height produced by almost any shape of piers whose horizontal sections do not change with the elevation. Flow round pier noses is discussed. As far as practical application is concerned the important results of this investigation consist in the conclusion that the backwater at bridge piers and its detrimental action are highly over-estimated in most cases and cases in which shooting flow occurs and in consequence of which large backwater heights are in evidence, constitute exceptions.

VACUUMLESS DAM PROFILES. Translated by Mr. Edward F. Wilsey from " Wasserkraft und Wasserwirtschaft ", Vol. 31, 1936. Vitols.

In this paper a theoretical analysis is presented for the determination of the downstream profile of spillway dams which ensures safety as regards the development of negative pressures when water falls down the slope of the structure. The unfavourable action of negative pressures on spillways is first explained. Solutions of the problem by some other authors are discussed and finally the theoretical method developed by the author is described. The equations obtained indicate that the profile of a spillway with no negative pressure is a parabola, which is true providing the water particles, in the nappe move as a system of free solid particles in a vacuum. Since this is not the case the parabola has too much reserve against the formation of a vacuum and such a profile is uneconomical. Another equation is derived for calculating coordinates of the curve of the vacuumless dam profile and the method of calculation is explained.

Flow of Water in Steep Chutes with Special Reference to Self-Aeration. Translated from " Osterreichischen Ingenieur—und Architeckten-vereines ", Nos. 15/16 and 17/18, 1926. **Ehrenberger.**

> " Waste water from the upper pool at high head power plants is usually directed into tumble bays in which energy dissipation is artificially achieved. The severe shocks to which such devices are subjected as well as the large construction costs involved have led to the suggestion that this excess flow might be delivered by means of simple steep chutes. In such channels a self-æration takes place as a result of the frictional and air resistance. . . . . The lack of experience with this type of overflow works as well as the fact that science of flow in steep chutes is still an almost unexplored field suggested that an experimental study of this flow and the accompanying phenomenon of self-æration was most desirable. The experiments described herein were made in the Hydraulic Structures Research Institute ".

The object of the experiments was to establish a relation between the average sectional velocity, the slope and hydraulic radius for slopes up to 70 per cent. In addition to this an attempt was made to find a relation between the average æration at a cross section, the slope, and hydraulic radius. The layout of the apparatus and general plan of the investigation is described in detail. The results obtained and the formulæ derived on their basis are given.

The Flow Around Bridge Piers of Different Shapes and its Effect on the River Bed. Translated by Mr. Edward F. Wilsey from " Die Bautechnik ", Vol. 10, 1932. Keutner.

Experiments carried out in a flume at the Hydraulic Research Station of the Technical University at Danzig for the determination of the proper pier shape and effective prevention of scour at the nose are described and results are discussed. Conclusions are given.

U. S. Department of Commerce (National Bureau of Standards).

Current Hydraulic Laboratory Research in the United States. Bulletin VI, January 1, **1938.**

This bulletin gives a list of hydraulic research projects in progress at various centres in the United States. Brief details as to the nature of the research, the object of the investigations, methods and scopes, the progress made, and names of investigators, are given for each project. A list is also given of foreign research publications translated by various authorities in the United States. Foreign pamphlets received by the National Bureau of Standards and available for loan are also listed.

Catalogues.

Catalogue of Publications of the United States Geological Survey—Geology and Water Supply. (Price List No. 15—28th Edition).

Catalogue of U. S. Government Publications on Engineering and Surveying. (Price List No. 18—27th Edition, June 1937).

Catalogue of U. S. Government Publications on Irrigation, Drainage and Water Power. (Price List No. 42—29th Edition, March 1937).

Catalogue of U S. Government Publications on Roads. (Price List No. 45—27th Edition, November 1937.)

Catalogue of U. S. Government Publications on Agricutural Chemistry and Soils and Fertilizers. (Price List No. 46—34th Edition, April 1937).

University of Arizona.

Phymatotrichum (Cotton . or Texas) Root Rot in Arizona. Technical Bulletin No. 71, September 15, 1937. **Streets.**

This bulletin deals with the cotton root rot disease which is one of the most destructive of plant diseases.

University of California.

Ship Model Towing Tank. Reprinted from the July 1935 issue of " Pacific Marine Review ". **Stewart.**

A testing tank for tests in connection with models of ships is described herein. In conjunction with tests with models of ships on resistance to motion, investigations have also been made on wave motion, wave resistance and self propelled model tests.

Annual Report of the Colorado Experiment Station, 1936-37.

The activities of the various sections of the Experiment Station during the year are described. Research projects in progress are mentioned. In the Civil Engineering section the work carried out consisted mainly of experiments with road surfacing and tests of various road materials. Work in the Irrigation Investigation section included the design of an adjustable tube orifice meter and experiments with Parshall measuring flumes. The study of the effect of pumping for irrigation on flow in rivers is also contemplated.

University of Florida.

EFFECTS OF FREEZING TEMPERATURES ON SUGARCANE IN THE FLORIDA EVERGLADES. Bulletin 278, May 1935.

Bourne.

Deterioration of sugarcane in frosty weather is discussed.

ILLINOIS STATE WATER SURVEY. Bulletin No. 31.

" The purpose of this bulletin is to make available a large mass of data in such a form that it can be used for the preparation of plans for future needs and growth by water supply engineers and others interested in the development of water resources in the State of Illinois ".

ELECTRIC POWER FOR IRRIGATION IN HUMID REGIONS. Committee on the Relation of Electricity to Agriculture, Chicago, Illinois, Bulletin Vol. VII, No. 2, July 1937.

Methods of irrigation in use in the humid regions of the United States where the annual rainfall is 20 inches or more are discussed. These include spray irrigation, surface irrigation, irrigation by porous hose made of canvas or other tight weave fabrics and subsurface irrigation. The features of the various methods are described. Sources of water for irrigation are then discussed. Pumping from wells for irrigation is treated in some detail and various types of pumps with their capacities and efficiencies are described. Electric power for irrigation pumping is efficient, reliable, safe and comparatively low in first cost and operation. Features of electric motors and other equipment for pumping are discussed briefly.

University of Iowa.

VACUUM-BREAKER DEVELOPMENT FOR BACK-SIPHONAGE PREVENTION. New Series No. 338, July 15, 1937.

Dawson.
Kalinske.

Back siphonage is the process of flowing back of polluted or infected material or liquid into the water supply lines due to the formation of a less than atmospheric pressure in such supply lines. This paper deals with the means of protection against back siphonage and the hydraulic, pneumatic and practical problems concerned with scientifically correct protection.

FLOW OF WATER AROUND 180-DEGREE BENDS. New Series No. 339, August 1, 1937.

Yarnell.
Woodward.

' The results of a series of experiments on the effects of 180° bends of square and rectangular cross section on the flow of water are presented in this bulletin. The investigation was undertaken for the purpose of exploring the laws governing the changes in pressure and velocity in different parts of the flowing stream as the moving water undergoes the transition from motion along a straight path to motion around a curve and again as it undergoes the opposite transition.

CHECK LIST AND PRICE LIST OF UNIVERSITY STUDIES. New Series No. 922, July 10, 1937.

The check list contains information on all the publications of the University with the exception of the catalogues and purely administrative publications.

University of Minnesota.

NOTE ON COMPUTATION OF NON-SILTING CANALS. Translated by Mr. George Riedel from the Russian by aid of Works Progress Administration, University of Minnesota, Sub-Project No. 40. Uginchus.

During the design of an irrigation project " Golodnaja step " (Hungary prairie) in 1929 the development of a method of computation for non-silting canals was assigned to the author of this article. As a result of original data and analyses of observations made by Kennedy on Indian canals, there was obtained a new relation for a critical non-silting velocity expressed in terms of the hydraulic radius. A similar relation had been developed earlier by Mr. G. Lacey unknown to the author till some time after making his own investigations. In comparing the formulæ proposed by Mr. G. Lacey with those developed by the author it is found that notwithstanding the mutual original dependency for critical velocity further conclusions differ materially. Some of these points of difference are discussed. The author then proceeds to explain the method of analysis in detail and discusses the new relationships obtained by him. The new relationships obtained are not a simplification of Kennedy's basic formulæ since the conclusions are contradictory to Kennedy's theory of non-silting channels. Non-silting canals according to Kennedy should be wide and shallow while according to the relations obtained by the author they should be narrow and deep. Practical application of the developed relations is illustrated with reference to an example for the design of a canal. The same canal is then designed according to Mr. G. Lacey's formula and the results are compared. The disparity between the results is discussed.

NEW ZEALAND.

PUBLIC WORKS STATEMENT, 1937.

This is an annual report of the work carried out by the Public Works Department of New Zealand during the year on highways, railways, hydroeletric development, irrigation and water supply, public buildings, telegraphs, harbour works and lighthouses. A number of statements showing financial results, working costs, and statistics of hydroelectric works are appended.

INTERNATIONAL CONFERENCES, ETC.

International Congress of Mines, Metallurgy and Applied Geology.

Transaction of the VII Session held in Paris from 20th to 26th October 1935—Section of Applied Geology, Vols. I & II. (In French).

Contains the following articles of interest to irrigation engineers.

Some Means of Study of the Cycle of Water in Nature. — Dienert.

Subsoil Waters and their Strata. — Impeaux.

The Static Rise of Underground Water under the Influence of Atmospheric Precipitations. — Larsen.

This article describes experiments carried out to ascertain the effect of rainfall and other factors on the sub-soil water table in an area commanded by a canal.

(This article will be got translated shortly).

Danish Legislation on Water Supplies. — Lundbye.

Exploitation of the Sub-Terranian Waters in the Dry Regions of Nigeria. — Lundbye. Raeburn. Cochran.

OTHER PUBLICATIONS.

Pamphlet entitled " How to Make Good Water-proofed Concrete ", issued by Medusa Portland Cement Company, Cleveland, Ohio.

Pamphlet entitled " A Discussion on Integral Waterproofing by Medusa ", issued by Medusa Portland Cement Company, Cleveland, Ohio.

Catalogues on " Asbestos Cement ", issued by Asbestos Cement, Ltd., Bombay.

Catalogue of Worthington Deep Well Turbine, Pumps, Type QB, Bulletin W-450-B17 C.

CATALOGUE OF TYPE " L " STANDARD HORIZONTAL BALL BEARING CENTRIFUGAL PUMPS, ISSUED BY WORTHINGTON-SIMPSON, LTD., LONDON, BULLETIN WS-1317, SEPTEMBER 1937.

CATALOGUE REGARDING PUMPING EQUIPMENTS, ISSUED BY MATHER & PLATT, LTD., LONDON.

CATALOGUE OF COOK BRASS TUBE WELL STRAINER AND COOK WW STRAINER, ISSUED BY A. D. COOK, INDIANA (U. S. A.)

CATALOGUE OF COOK DEEP WELL TURBINE, ISSUED BY A. D. COOK, INDIANA (U. S. A.)

GROUND WATER, FIRST EDITION, 1937. Tolman.

" This book records the birth and describes the development of a new science—co-ordinated scientific data regarding the occurrence, motions and activities of sub-surface water and the hydrologic properties of water bearing materials known as Ground Water Hydrology ".

Intensive investigations beginning about forty years ago revealed the importance of ground water and many interesting phenomena accompanying its occurrence. This book is the first general treatise in English in which an attempt has been made to present the results of the intensive study of sub-surface water in Western United States where existence depends upon the exploration and development of ground water. The book is divided into 17 chapters covering over 560 pages. In the introductory chapter the history of ground water development from the pre-historic age to the present day is briefly reviewed and the development of ground water theory is traced. Chapter II is a resume of ground water hydrology in which the general scheme of the occurrence and motions of ground water with methods of investigation is presented preliminary to the more detailed technical discussion which follows. A clear picture is given of the origin, occurrence and behaviour of the unseen surface water bodies with brief reference to the practical application of the principles involved. The natural reservoirs which include the atmosphere, the oceanic water body, the surface fresh water body, and ground water reservoir, are described. The hydrologic cycle is discussed. Geology in relation to ground water and the occurrence of sub-surface water together with motions of underground water are briefly reviewed. Free and confined ground water is discussed and the application of ground water hydrology to questions of ground water litigation is indicated.

Chapter III contains a brief review of rainfall, run-off, evaporation, and transpiration. Rainfall conditions in the United States, climatic cycles, stream run-off and stream flow measurements, hydrographs, evaporation*and transpiration losses are amongst the subjects dealt with in this chapter.

Chapter IV discusses the hydrologic properties of various water bearing materials of the category of rock formations. Openings in rocks, the process of their formation and the relation of the openings to hydrologic properties are discussed.

Chapter V deals with the hydrologic properties of soil. General characteristics and properties of soils, seepage and percolation rates in soils, classification of soils, and composition of soils are dealt with.

Chapter VI deals with the occurrence of water and the driving forces which cause water movements in the unsaturated zone of aeration which is situated above the water table. Soil moisture, capillary action, and the process of delivery of water to plant roots are discussed.

Chapter VII deals with seepage into the subsoil from rainfall, streams, and other sources, and the process of artificial re-charge of ground water reservoirs, also known as water spreading. Various methods of water spreading and feeding water into the subsoil through shafts and wells are described.

Chapter VIII discusses percolation, the most important type of movement of ground water and various laboratory methods for its measurement. The development of laws expressed in mathematical equations governing the relation of percolation to permeability, ground water gradient, size of interstices, and diameter of soil particles is discussed. Turbulent and laminar flow in pipes are considered briefly as an introduction to the discussion of similar types of flow of ground water. Methods of determining permeability, and velocity in various types of granular material are discussed.

Chapter IX deals with the occurrence and movement of ground water and the relations of the water table to ground water movement in pervious granular materials. The development of water table profiles under various conditions of subsoil stratifications, effect of surface topography, ground water mounds and ridges, bodies of fresh ground water floating on salt water, water table maps, and geophysical and electrical methods of locating water table and bed rock are dealt with in this chapter.

Chapter X. describes ground water conditions in rock formations of various types.

Chapter XI is concerned with ‘ confined ’ water or water informations not in hydraulic connection with overlying water bodies except at the fountain head. Confined water includes artesian supplies. Artesian wells are described and hydraulic principles of confined percolation are discussed. Pressure changes due to pumping and the effect of pumping on the water bearing formation of artesian wells are described. Effect of earthquakes on water levels in wells is discussed. Comparison is made of the effects of pumping confined and free water.

Chapter XII deals with the geology of the principal types of formations in which artesian supplies are found. Alluvial cones or fans deposited at the foot of a range of hills are the great water producers in Western United States. Pressure water in alluvial cones and fans has been studied in more detail than any other occurrence of confined water. The formation of the alluvial cones, and groundwater movement in them are discussed in detail.

Chapter XIII deals with the hydraulics of pumped wells. Two types of wells are considered, *viz.*, water table wells which tap the free ground water, and wells which tap confined water lying below a confining formation separating it from the free ground water. Cone of depression and area of influence are discussed and factors affecting quantity of flow from wells are considered. Various types of wells including excavated wells, bored wells, drilled wells, etc., are described, including the equipment employed.

Chapter XIV is concerned with the movement of fluids in oil fields during accumulation of hydrocarbons and after the pool is tapped by wells.

Chapter XV deals with springs. Characteristic features of various formation from which springs issue forth are described.

Chapter XVI describes the procedure of determining the additions of water to the ground water reservoir from all sources and the discharge of ground water of every kind for an area under investigation. The principles of this procedure of preparing a " ground water inventory " as it has been called, are explained.

Chapter XVII gives a regional classification of the United States and Hawaiian Islands based on the mode of occurrence of ground water.

The book contains a large number of plates and diagrams and references to copious literature on the subjects treated.

PROGRESS OF ENGINEERING IN INDIA DURING THE PAST TWENTY-FIVE YEARS. Ash.

This publication forms part of the Indian Science Congress Association's Jubilee Memoir, published on the occasion of the Silver Jubilee of the Congress in January 1938. It has been compiled from articles contributed by engineers describing the progress during the past twenty-five years in the particular branches of engineering with which they are associated.

Section I contains the introductory remarks of the compiler. Section II describes the characteristics and salient points in connection with a number of important schemes executed and is arranged under the heads Irrigation, Railways, Electrical Projects, Ports and Harbours, River Control, and Bridges. Section III describes the experimental work, research and investigations carried out in the field of irrigation, marine engineering and structural engineering.

The article on irrigation in section II was contributed by Mr. M. T. Gibling, Secretary, Central Board of Irrigation. The principal features of some important projects including the Lloyd and Wilson storage dams in Bombay, the Triple Canals and Sutlej Valley Projects in the Punjab, the Sarda Canal Project in the United Provinces, the Lloyd Barrage Project in Sind and a few smaller schemes in other parts of India. The functions and the objects of the Central Board of Irrigation and Information Bureau are also briefly mentioned.

Under electrical projects are described briefly the Glen Morgan, Pykara, and Mettur Hydroelectric schemes in Madras, Sivasamudram Hydroelectric scheme in Mysore, the Mandi Hydroelectric scheme on the Uhl River in the Punjab and the United Provinces Ganges Canal Hydroelectric Grid.

The section dealing with research gives in outline the research carried out at the Central Irrigation and Hydrodynamic Research Station, Poona, and the Punjab Irrigation Research Institute Lahore as described by Mr. C. C. Inglis, Director, Hydrodynamic Research Station, Poona, and Dr. McKenzie-Taylor, Director, Punjab Irrigation Research Institute.

A tidal model of the Rangoon River is under investigation by Sir Alexander Gibb and Partners in London and a brief description of the model is given. The model was constructed to a horizontal scale of 9 inches to one sea mile, a vertical scale of 1/16 inch to 1 ft. and a time scale of 1 : 583 so that one year occupied 15 hours running of the model. Conclusions reached from investigations with this model are given. Another model described is that of Bombay Harbour.

ON UNSTABLE VORTEX MOTION. Reprinted from Journal of the Aeronautical Sciences, Vol. 2, No. 4, July 1935. — Carter.

Description is given of an experimental study of vortex formation and the motion of vortices. The apparatus used and the results obtained are described.

PROSPECTING FOR WATER WITH GEOPHYSICAL METHODS. Reprinted from Transactions of the American Geophysical Union, Eighteenth Annual Meeting, 1937. — Heiland.

The principles, methods, and instruments used in the location of ground water by the geophysicist are described in this paper. Results obtained with various types of geophysical methods in water location are discussed. The economic aspects of geophysical water location are discussed.

MODELS OF ESTUARIES. Reprinted from Transactions of the American Geophysical Union, Sixteenth Annual Meeting, 1935. O'Brien.

This article deals with the principle of design of models of estuaries for investigation of estuary problems. The dimensions and other characteristics of a number of estuary models built in England and the United States are given. The distortion of scales of an estuary model, the selection of horizontal and vertical scales, the determination of size of bed material for models, bed slopes in models, and time scales are discussed. The Columbia River model is then described and its design features are discussed. The progress of experiments and the future programme of investigations with this model are described.

NOTES ON THE TRANSPORTATION OF SILT BY STREAMS. Reprinted from Transactions of the American Geophysical Union, Seventeenth Annual Meeting, 1936. O'Brien.

This paper discusses the problem of transportation of bed load and suspended material by flowing water. A theoretical discussion of tractive force in the uniform flow of water in an open channel is given and expressions for tractive force are derived. Critical tractive force is discussed, and the rate of bed movement is investigated. The experimental work is reviewed in the light of theory and the general applicability of the results is discussed. It is concluded that experiments in the laboratory on the transportation of silt specially on bed movement, have not yielded results which can be used with confidence for estimating the transport of natural streams. Extensions of present methods to larger flumes and small natural channels promises to be equally inconclusive although such work may yield approximate formulæ. To provide a satisfactory basis for computing transport it appears to be necessary to examine the phenomenon in detail, especially in the region immediately adjacent to the bed. This work will require improved sampling devices and instruments capable of indicating velocity fluctuations, and should be planned so as to utilize our present knowledge of turbulent flow.

A SHORT NOTE ON THE METHOD OF SILT INJECTION AT THE CENTRAL IRRIGATION AND HYDRODYNAMIC RESEARCH STATION AT LAKE FIFE, POONA. Inglis.

The method of silt injection in the 1/500 scale model of the Ganges at Hardinge Bridge on the Eastern Bengal Railway is described in this note. The method described ensures the silt going into suspension. The silt is injected into the leading channel a short

distance upstream of the model. A grid is placed in this channel just downstream of the point of injection to create disturbance. Above the upstream end of the model, a shallow silt pit is created by means of regulator gates. The gates are manipulated to maintain the depth in the pit at a pre-arranged figure. The silt deposited in the pit is removed at frequent intervals. The water passing over the regulator gates into the model carries the silt in suspension.

DETAILS OF THE DESIGN OF PROPORTIONAL STANDING WAVE FLUME METER FALL AT R. D. 40280 MONTGOMERY-PAKPATTAN LINK.

Calculations for the design are given with explanations. This is one of the falls of alternative design to be constructed for co[illegible] purposes.

Pvkara,

NOTE ON THE DESIGN FOR STANDING WAVE FLUMES ON THE JODHPUR LINED WATER SUPPLY CHANNEL.

Two designs of standing wave flumes one for 30 cusecs at the head of the channel and one for 20 cusecs at the tail of the channel were prepared at the Central Irrigation and Hydrodynamic Research Station, Poona for the Public Works Minister, Government of Jodhpur. Discharge curves and detail of gauge chambers were also supplied. The drawings of the flumes and copies of discharge curves, etc., are attached to this note and the calculations for the discharge are explained.

NOTE DATED FEBRUARY 15, 1938, ON THE UGUINCHUS SYSTEM OF NON-SILTING CANAL DESIGN.

Lacey.

In this note Mr. G. Lacey critically discusses Mr. Uguinchus' theory of non-silting canal design. He points out that Mr. Uguinchus is fundamentally in error inasmuch as he fails to realize that the rugosity coefficient is a function of the silt grade. He also ignores the lateral action in channels which assigns shape. He does not visualise a channel flowing in its own incoherent alluvium and deals apparently with a channel excavated in tenacious material with the silt transported in suspension rather than by bed traction in which the bed silt grade determines the rugosity coefficient.

Mr. Lacey held much the same views as Mr. Uguinchus in 1925 and 1926 when he was Personal Assistant to Chief Engineer of the Sarda Canals which were under construction. He employed the equation $V=1{\cdot}16\ R$ and associated it with the Kutter equation which is all that Mr. Uguinchus does. Experience with the Sarda Canal channels, many of which have either silted or scoured, has shown that the theory was incomplete. Mr. Lacey's later theory has been proved to be correct by many successful applications in the field.

NOTE ON THE USE OF AUTOMATIC FALLING SHUTTERS ON WEIRS IN INDIA. Wheatley.

This note is in reply to certain questions raised by the Secretary, International Commission on Large Dams, Paris. concerning automatic falling shutters on weirs. A brief description is given of the Ashford automatic falling shutter invented by Mr. Ashford, Superintendent of the P. W. D., Central Workshop at Amritsar in 1919 [illegible] shutter is used extensively in the Punjab and [illegible]. The questions raised by Mr. Aubert, [illegible] International Commission on Large Dams, Paris, [illegible] greatest practicable height obtained with this device, [illegible] of operation for raising and lowering the shutters, [illegible] for the reference given to this system, and incidents [illegible] damages caused owing to shocks against the gates. Replies [illegible] these questions are given.

MODIFIED I. S. A. ORIFICE WITH FREE DISCHARGE. Reprinted from A. S. M. E. Transactions for January 1937. O'Brien. Folsom.

In this paper results are presented of experiments with a modified type of International Standard Orifice as used for metering pump discharges.

RESEARCH IN FLUID MECHANICS. Reprinted from the Journal of Applied Mechanics for December 1936. O'Brien. Folsom.

This note on progress in fluid mechanics since January 1935 presents short summaries of selected articles dealing with the subject and a bibliography of publications on the subject. Selected articles summarized include those on turbulence, pipe flow, metering, pitot tube standardization, and hydraulic machinery.

THE TRANSPORTATION OF SAND BY WIND. Reprinted from Civil Engineering for May 1936. O'Brien. Rindlaub.

Preliminary studies of erosion of the beach at the mouth of the Columbia River suggested that wind drift was an important factor To investigate the order of magnitude of this drift a series of measurements were made under varying weather conditions. Results of these measurements are presented in this paper. A curve showing the rate of sand movement in lbs. per ft. per day corresponding to velocity of wind in ft. per second is given.

BIBLIOGRAPHY ON IRRIGATION OUTLETS.

A list of publications dealing with irrigation outlets.

COPY OF LETTER DATED 20TH JANUARY 1938 FROM MR. C. C. INGLIS TO THE EDITOR, " INDIAN ENGINEERING ", REGARDING AN ARTICLE ENTITLED "CONSIDERATION OF SLOPES OF FLO[illegible] THE DESIGN AND MAINTENANCE OF [illegible] IAL CHANNELS " BY R. K. KHANNA IN THE 1937 ISSUE OF THE JOURNAL.

For abstract see under " Indian En[redacted]Bulletin.

EXPANSIONS OF THE HEADINGS OF DTHEEWEY DECIMAL CLASSIFICATION ADOPTED IN THE OSMANIA UNIVERSITY LIBRARY WITH REGARD TO ORIENTAL AND ISLAMIC SUBJECTS.

COPY OF A LETTER FROM MR. C. C. INGLIS TO CAPT. G. F. HALL, CHIEF ENGINEER, PATNA, DATED 10TH FEBRUARY 1938 REGARDING EROSION OF THE RIVER BUR GANDAKA AT SIKANDARPUR IN MUZAFFARPUR DIVISION.

Certain papers were sent by Capt. G. F. Hall, M.C., C.I.E., to Mr. C[illegible] Inglis, C.I.E., Director, Hydrodynamic Research Station, Po[illegible], concerning the erosion of the river Bur Gandaka. Mr. Inglis in reply makes some remarks on the hydrodynamic problem. He says that spurs, pitched banks and walls have a very strong attraction for water and cause an enormous intensification of attack. They do more harm than good in the long run. The scour in the River in question could be remedied by making a cut. The correct point of offtake for the cut has been indicated in the plan. Wave action is certainly not the cause of erosion which starts at the toe of the pitching which collapses into the hole thus formed. What happens is that water impinging on a bank, specially if it is at right angles, dives down and creates curved surging flow at the bed which causes the formation of pulsating vortices and washes away even large stones. The filling of the river bed with old trees fallen in past years is an important factor in the swinging of the river channel as is evidenced by the fact stated some years ago by a writer in the Engineering News-Record that after stumps of trees had been removed from the bed of the Missouri River it decreased its length by 100 miles in a length of 400 miles.

BROADCAST TALK ON " THE IMPORTANCE TO BENGAL OF ITS RIVERS " ON 16TH NOVEMBER 1937. Curry.

Mr. Curry briefly describes the alluvial features of Bengal and explains the process of delta building with reference to the Ganges and the Brahmaputra, the deltas formed by which constitute a large part of the Province of Bengal. The changes in the course of these rivers during the process of delta building are described. The evil effects of interference with the natural action of rivers by construction of embankments are explained. The importance of Bengal rivers for communication and transport and for the health, prosperity and welfare of its inhabitants is emphasized.

IRRIGATION. **Simcox.**

(Extract from Journal of the Indian Merchants' Chamber, Bo[illegible] 1937.)

This is a [illegible] Journal of the Indian Merchants' Chamber, Bo[illegible] the method of irrigation practised in river-[illegible] have been constructed centuries ago to [illegible] of the water and small canal taking off above the [illegible] water to the fields. A series of dams may be found in [illegible] about one to three or four miles apart. The rotation [illegible] time for crops adopted is described. The ownership of the lands is individual, nor communal, but each owner must submit [illegible] the general rotation. All this is done by absolute time honoured indigenous co-operation. There are no laws to regulate the rotation and its affairs never appear in court. The author concludes with a plea for the introduction of this system in all the canal systems.

[illegible] INSTITUTION OF ENGINEERS, AUSTRALIA, LIST OF MEMBERS, 1937.

MAPS, BLUE PRINTS AND PHOTOGRAPHS.

(Herein are given only those blue prints, etc., which are not accompaniments to any publication or note.)

Bihar and Orissa.

Map showing the chief mineral deposits of Bihar and Orissa.

Geological map of India and adjacent countries. Sheet 7—Orissa.

United Provinces.

Ganges Grid Scheme.

Photograph of the State Tube Well No. 31, Bhatipura Block.

Two blue print sketches showing lab. performance of two types of Cook's pumps installed on the tube wells.

Blue print showing typical arrangement of Cook's deep well turbine.

Plans showing pumping sets supplied by Mather and Platt, Ltd., Calcutta.

Nine blue print sketches of centrifugal pumps supplied by Worthington Simpson, Ltd., Calcutta.

Drawings of deep well pumps supplied by Byron Jackson Co.

Sarda Canal.

Record plan of V. R. Bridge combined with 5·0′ fall at mile 90—1—286, Kheri Branch, Sarda Division.

Graph showing catchment areas of drains and factors deduced from observed discharges of 1936 floods.

Longitudinal sections of Qutubpur, Gaindipur, Kathwa, Kursi, Dhandia, and Sankhani Nala drains.

Index map showing drains and distributaries.

Punjab.

Haveli Project.

Longitudinal section of Montgomery-Pak[illegible]aveli Project) from R. D. 28000 to 46000 showing pr[illegible] for falls.

NEWSPAPER CUTTINGS.

AERIAL SOIL SURVEY: LAND DETERIORATION IN PUNJAB. January 1, 1938.

With the approval of the Chief Engineer for Irrigation in the [illegible]b[illegible] experiment is being started by Raja Narendra Nath u[illegible] direction of the Punjab Irrigation Research Institute in [illegible] of prevention of land deterioration. It is proposed to ma[illegible] survey of fields which have begun to give low yields of wheat [illegible] some preliminary work on the possibility of using aerial photographs for classifying various types of soils has been conducted in the Punjab. Lands giving low yields will then be treated with gypsum on the basis of their calcium deficiencies and the effect of this on the yields will be studied.

GOLD CARRIED BY INDUS: APPEAL FOR CHECKING VELOCITY OF RIVER. January 4, 1938.

Dr. A. L. Coulson, Superintending Geologist of the Geological Survey of India in the course of a paper emphasizes the need of checking the high velocity of the Indus in summer by means of wooded "be-las" so that the heavy mineral particles containing gold may not be rolled down. He says that such wooded "belas" should not be far from the main channel of the river.

GOLD IN THE INDUS: DR. COULSON'S THEORY. GRAVEL SHOULD BE SAMPLED. January 4, 1938.

Same as above.

CONTROL OF WATER HYACINTH: DACCA SCHEME. January 5, 1938.

This is a Bengal Govt. Press Communiqué giving a review of the first year's working of the Arial Bil Water Hyacinth Control Scheme of Dacca. It is shown how at a very low cost much of the land, which previously was the breeding ground for water hyacinth and other noxious weeds, was reclaimed and brought under paddy cultivation. The cultivators had to pay 1 per cent. of the produce towards meeting the cost of reclamation. 1,600 acres of reclaimed land were brought under plo[illegible] 937 ; the value of the produce being about Rs. 50,000 [illegible] t of Rs. 500.

U. P. CHIEF ENGINEERS N[illegible] WORK. January 5 [illegible]

The sen[illegible] se of Chief Engineers in [illegible] P. has been sanctioned [illegible] neers were also Secre-

[illegible]

[illegible] January [illegible]

[illegible] the Completion Report of the Lloyd [illegible] e effect that the project has effected some- [illegible] eficent revolution in the life of the new Province

[illegible] MIES : THREE ENGINEERING POSTS ABOLISHED. January 7, 1938.

It is understood that the U. P. Govt. will effect a saving of about Rs. 1 lakh annually in the Communication Department by the abolition of a post of Chief Engineer and two posts of Superintending Engineers. No appointments will be made on the retirement of Sir William Stampe, Chief Engineer, Irrigation, and Mr. Bradshaw Smith, S. E., while the abolition of the post of another S. E. is under contemplation.

BENEFIT OF IRRIGATION IN BENGAL : ESSENTIAL FACTOR FOR RURAL DEVELOPMENT. January 7, 1938.

Mr. S. C. Majumdar, Superintending Engineer, Bengal Irrigation Department, in a broadcast talk, stressed the necessity for irrigation in the western district, where, he said, though the total monsoon rainfall was normally adequate, its distribution especially towards the end of September and October was erratic and irrigation was needed to ensure a good harvest even in normal years. In years of low rainfall, it was a vital necessity in order to combat famine.

PUNJAB'S WIDE NET-WORK OF CANALS : ENGINEERING TRIUMPH IN SUTLEJ VALLEY. January 7, 1938.

This is an " Unofficial Note " on the Sutlej Valley Project, issued by the Director of Public Information, Govt. of India. For notes see under " Govt. of India " in the Literature Section.

STUDY OF SIND BARRAGE CULTIVATION. January 8, 1938.

Dr. J. D. Tothill, Director of Agriculture in Uganda is at present in Sind studying agricultural conditions in the Barrage irrigated areas, particularly in respect of [illegible]ton growing and the systems of marketing. From Sind he [illegible]cted to proceed to the Punjab, U. P. and Bombay.

PROBLEMS OF SOIL SURVEY: LOCA[illegible] VITAL. January 8, 1938.

Sir Bryce Burt's Presidential address a[illegible]ting of the Indian Society of Soil Science.

IRRIGATION DUES: INQUIRY COMMITTEE IN UNITED PROVINCES. January 9, 1938.

The U. P. Govt. have appointed a Committee u[illegible] the Chairmanship of the Minister for Communication and Irrig[illegible]n, to consider the working of the canal rules and of the agency em[illegible]yed for the collection of irrigation dues, and to examine the expen[illegible] Irrigation Department, including the hydro-electric bra[illegible] to suggest means whereby it can be reduced.

U. P. IRRIGATION: INQUIRY COMMITTEE FOR EXPENDITURE. January 10, 1938.

The same as above, but gives, in addition, the names of the Members of the committee.

POSTS NOT ABOLISHED BUT WERE ONLY TEMPORARY: U. P. IRRIGATION BRANCH OF THE P. W. D. January 11, 1938.

In connection with the reports that three posts in the Irrigation Branch of the P. W. D., U. P., have been abolished, it is stated that it has been reliably learnt that all these posts were created temporarily for the period during which the Hydro-Electric and Tube-well schemes were being matured.

FISH FARMING IN THE PUNJAB: SUITABLE STOCK: AVOIDING CARNIVOROUS SPECIES—by Dr. Hamid Khan Bhatti.

IRRIGATION COMMITTEE FORMED. January 12, 1938.

Same as the news contained in cuttings dated January 9 & 10.

IRRIGATION RESEARCH: PROPOSAL FOR CENTRAL INSTITUTE. January 14, 1938.

States that it is understood that a proposal has been forwarded to the Indian Government by non-official institutions for the establishment of a Central Research Institute, either in Delhi or Poona to cater for the irrigation needs of the whole of India. It also states that it has been proposed that every Province should contribute Rs. 20,000 for the establishment and maintenance of the Institute.

More Funds for Nation-Building: Sind Reorganisation Interim Committee's Recommendation: Substantial Economy in Public Works Department: Reduction in Allowances Proposed: Two Superintending Engineers' Po[illegible] January 15, 1938.

Consid[illegible]t in allowances and reduction of certain posts [illegible]. (including two posts of Superintending Engineer) [illegible] proposed by the Sind Reorganization Committee [illegible]

Canal [illegible]excavation. January 18, 1938.

[illegible] public meeting held at Bhojeswar village (Bengal) under the presidency of Mr. K. A. L. Hill, I.C.S., district magistrate, it was decided to raise funds for the purpose of re-excavation of the Bhojeswar-Bhedergunj canal and to consult experts of the Irrigation Department. A committee has been formed with the S. D. O. of Madaripur as president.

Cut in P. W. D. Staff: Recommendations of Sind Committee. January 18, 1938.

Same as the news in the cutting dated January 15.

Occasional Notes. January 19, 1938.

Two new railway lines are to be constructed in the Lloyd Barrage area in Sind.

Better Irrigation of Lands · Schemes being Formulated by Derajat Authorities. January 19, 1938.

Various schemes for supply of drinking water and better irrigation of lands, it is understood, are being formulated by Derajat district authorities (N.-W. F P.) for being finally put before the Provincial Govt.

Mysore Irrigation Project, New Reservoir: Foundation Stone to be Laid by Ruler. January 20, 1938.

His Highness the Maharaja of Mysore will lay the Foundation stone of the Marconahalli Reservoir in Kunigal Taluk, Tunkur District on Thursday, the 20th January 1938.

This reservoir is to be constructed across the Shimsa river about 300 feet below its confluence with the Viravaishnavi and about

4 miles below the Yediyur Bridge in mile 6/57 of the Bangalore-Mangalore Road. The total catchment area of the reservoir is 1,584 sq. miles and is expected to yield 56,264 units. The length of the dam when finished will be 456 ft. and the height in the deepest portion above the river bed will be 73 ft. The dam is to be pierced with five sluices. The waste weir is to be located on the right where a defined valley exists. Two siphons of 8 ft. dia. are to be installed in the body of the dam. The irrigation channel will be 18½ miles long and will command 11,700 acres of which 10,000 will be brought under cultivation. It is estimated to cost Rs. 22 lakhs and the [illegible] return on this capital is expected to be 4·81 per cent.

The Uhl River Hydro-Electric Project : Supply of Electricity to 19 Towns in the Punjab January 21, 1938.

This is an " Unofficial note " issued by the Director of [illegible]tion, Government of India. For notes see under [illegible] of India Publications in the Literature Section of th[illegible]

Hydro-Electric Scheme in U. P. : Important Surveys : Rs. 28 Crore Expenditure on Irrigation. January 22, 1938.

This is a review of the Administration Report of the Irrigation [illegible] of the P. W. D., U. P. for 1936-37. Figures of income and [illegible]penditure, areas irrigated, etc., are given. As regards further development of irrigation, it is stated, that important surveys for a possible hydro-electric scheme in the Vindhya hills were carried out in Mirzapur and in Rewa State and the project was submitted to consulting engineers in London for scrutiny. Surveys were also completed for irrigation schemes by pumping from the Ganges river in the Partabgarh and Allahabad districts and also from the Tons river in the Chhail Pargana of Allahabad.

New Reservoir : Foundation Stone Laid by Mysore Ruler. January 22, 1938.

On the occasion of the Foundation-Stone Laying Ceremony of the Marconahalli Reservoir in Mysore, His Highness the Maharaja of Mysore said that previously they hesitated to undertake any project unless it returned 6 per cent. on the capital invested but now they have not only to look for the return to the treasury but also for the wealth and happiness of the ryot which in itself affords a generous return.

Letters to the Editor : The Haveli Project. January 26, 1938.

This is a letter by S. Hari Singh, M.L.A., Punjab, in connection with his starred questions in the Assembly and the answers thereto by the Minister in charge of Irrigation. The questions aimed at eliciting information regarding the maximum capacity of the perennial channel to be taken off from the Headworks at Trimmu and the supply normally available in the river particularly in December. From the replies he concludes that there will not be sufficient water in the river for the canal to run with full supply particularly in December [illegible]n the water is most needed for irrigation of wheat.

New Political Ec[illegible]uary 26, 1938.

Editori[illegible]h of His Highness the Maharaja of Mysore [illegible] Foundation-Stone Laying Ceremony of the [illegible]. (See cutting dated January 22.)

P[illegible], Director (Offi- [illegible]search, Punjab, [illegible]hore with Professor [illegible] 23, 1938.

[illegible] to Study Canal Problems. [illegible] 28, 1938.

States that the Governor of Sind, Sir Lancelot Graham, plans a flying visit to Sukkur in the second week of February to study the problem of silting canals, which is causing concern to the Irrigation Department.

Hydro-Electric Schemes in U. P. January 30, 1938.

Editorial notes on the Administration Report of the Irrigation Branch, P. W D., U. P., for 1936-37 (See also cutting dated January 22.)

Government Test House : Extension of Work at Alipore. February 2, 1938.

The Government Test House, situated at Alipore, is an institution under the control of the Government of India and is incorporated in the organization of the Indian Stores Department. The work of the Test House is extremely varied and almost any material purchased for the consuming departments of the Government is liable to be tested in this institution

Mr. Sidney Preston : Death of Former P. W D Engineer. February 2, 1938

The late Mr. Sidney Preston, C I.E., entered the Indian Public Works Department in 1870 and was employed in irrigation work in the U. P. and the Punjab and retired in 1905 after having held the posts of Secretary to the Government of India, P. W. D., and Inspector-General of Irrigation.

The Unao Experiment. February 2, 1938.

Some zamindars of Unao (U. P.) have succeeded in reclaiming some Usar land in their possession by ploughing in green manure. In 22 out of 24 plots "sanai" was sown after "paleo" with canal water and ploughed in, while in the two other plots rice was sown without the green manure, other conditions remaining the same. The yield in the "sanai" plots was 24 maunds per acre, while the unmanured plots yielded only 11 maunds per acre.

U. P. ASSEMBLY: COST OF EXODUS TO HILLS: IRRIGATION RATES: CRITICISM OF HONORARY MAGISTRACY. February 3, 1938.

The Public Works Minister faced a [illegible] of questions relating to canal rates and tube-well water rates. [illegible] announced that engineers had been asked to work out uni[illegible] order to equalize the charges made under the two [illegible]

RIVERS THREATEN ASSAM ROADS: OFFICIAL REPORT: HAVOC OF FLOODS LAST YEAR. February 5, 1938.

A brief review of the Administration Report of the P. W. [illegible] for 1936-37. Mentions floods during the year and the [illegible] by them. Gives also the changes in the course of certain [illegible] It is stated that erosion on the left bank of Brahmaputra continued during this year also and Mr. T. A. Curry, Chief Engineer, Bengal was called to inspect it and suggest means for dealing with it. Mr. Curry suggested a scheme costing about Rs. 17 lakhs but on account of the heavy cost no action has yet been taken on the proposal.

BUILDING ROADS WITH MOLASSES: RESINIFIED COMPOUND: RESULTS OF INTERESTING EXPERIMENTS. February 5, 1938.

A note issued by the Imperial Institute of Sugar Technology says that attempts to convert molasses into an insoluble resinous product suitable for use as road surfacing material have been fairly successful.

WESTERN JUMNA CANAL: DELHI IMPROVEMENT TRUST SCHEME. February 7, 1938.

The last remnant of the Western Jumna Canal, known in Delhi as Nahar Saadat Khan will soon disappear as the Delhi Improvement Trust have decided to have it filled in as it was proving a breeding ground for mosquitoes. This canal was originally constructed during Emperor Shah Jehan's rule to water the Moghul gardens. Some portion of the canal have already been filled in on account of the pressure on space exerted by the growing population of Delhi and the city's consequent expansion.

BETTER IRRIGATION FOR BOMBAY: INQUIRY IN KARNATAK. February 10, 1938.

The committee recently appointed by the Bombay Government under the Chairmanship of Sir M. Viswesvaraya to investigate into the present condition of irrigation in the Presidency held its sittings at Dharwar for three days from February 3. The witnesses were of the opinion that the existing irrigation conditions were unsatisfactory and required considerable improvement. It was further pointed out that tanks played a vital part in the Karnatak, and there were nearly 5,000 of them irrigating over 100,000 acres, but as most of the tanks had silted up they required immediate attention. In the eastern dry tracts the harnessing of nullahs for irrigation purposes was suggested.

Irrigation S[illegible]r Khajuri Plain. Feb- [illegible]

[illegible] scheme estimated to cost Rs. 5 lakhs has been pre[illegible] which when completed will transform the barren Khajuri [illegible] N.-W. F. P.) into rich arable land Water will be taken from natural springs in Jabbatangi inhabited by the Kambarkhel [illegible]idis.

Check to Famine : Punjab's Progress : attempts at Canal Building. February 1938.

This is a broadcast talk by Mr. A. M. R. Montagu, Officer on Special Duty, Punjab Irrigation, and formerly Secretary, Central Board of Irrigation. The development of irrigation from the ancient well system to the modern canal and electrically driven tube well is outlined.

Central Board of Irrigation : Mr M. R Richardson, New President. February 10, 1938.

A short biographical sketch of Mr. M. R. Richardson, C.I.E., Chief Engineer, P. W. D., Irrigation Branch, U. P., who has been elected President of the Central Board of Irrigation for 1937-38. A photograph of Mr. Richardson is also given.

Haveli Irrigation Project : Punjab Governor Lays the Foundation Stone : "Great and Lasting Benefit". February 11, 1938.

Gives H. E. the Punjab Governor's speech at the Foundation-Stone Laying Ceremony of the Haveli Project, Punjab This scheme is designed to provide perennial irrigation for about 700,000 acres and non-perennial irrigation for about 860,000 acres and is estimated to cost over Rs. 5 crores H E. dealt with the financial aspects of the project and also with its technical merits, particularly with the proposal to line 43 miles of the Main canal with reinforced brick masonry, which will reduce to a very large extent the menace of waterlogging in that tract, which otherwise would have resulted from seepage through the canal bed.

Editorial Note: Irrigation in the Punjab. February 11, 1938.

Editorial note on the speech of H. E. the Governor of the Punjab delivered at the Foundation-Stone Laying Ceremony of the Haveli Project.

Haveli Project Inaugurated by Governor: Foundation-Stone Laid: Punjab Irrigation: Scheme Estimated to cost Rs. 4 crores. February 11, 1938.

Gives a few remarks from H. E. the P[illegible] at the Foundation-Stone Laying Ceremony, of [illegible] and also a short description of the project.

Agriculture Study: Proposed College for Sind. February 12, 1938.

States that Sind Government intends setting up an Agricultural [illegible] at Sakrand where practical training in agriculture with [illegible] reference to Barrage conditions and estate management w[illegible] given.

Tube Well Scheme: 20,000 Gallons Per Hour Expected. February 12, 1938.

States that it is understood that an elaborate scheme for supply of water for military purposes is to be opened at Jubbulpore. The scheme includes the sinking of several tube wells each one of which, according to air-lift tests, will supply approximately 20,000 gallons per hour.

Reduction of Canal Rates. (Letter to the Editor). February 14, 1938.

This is a letter by Mr. Ram Chandra Sharma of Meerut. He gives the grievances of the peasants, namely, high canal rates, payment of full charges even if the crop is damaged or is insufficiently irrigated, insufficiency of water available for irrigation, and the damage to irrigable lands by borrow-pits dug for the purpose of taking clay for repairing banks, etc. He urges redress of these grievances and lays particular emphasis on the reduction of canal rates which he says have not been reduced even though the prices of agricultural produce have fallen very low.

Occasional Notes. February 15, 1938.

A note regarding the benefit to the Punjab likely to result from the Haveli Project.

Desert Transformed: Irrigation Projects in Punjab and Sind. February 25, 1938.

Mentions the benefit from the Triple Canals Project in the Punjab.

ELECTRIC POWER FOR 19 PUNJAB TOWNS: THE UHL RIVER PROJECT: 15,000 FEET TUNNEL. February 25, 1938.

This is an "unofficial note" issued by the Director of Public Information, Government of India. For notes see under Government of India publications in this Bulletin.

TRAVANCORE LOOKS AHEAD: THE PALLIVASAL HYDRO-ELECTRIC [illegible] STATE-WIDE GRID [illegible] February 25. 1938.

[illegible] the Pallivasal Hydro-Electric Scheme in Travancore which is likely to be completed by the end of 1938. The present programme of power development consists in diverting the water of the Mudirapuzha River (a tributary of the Periyar) which has many falls with a total head of 1,990 feet distributed over three miles. Diversion will be effected by construction of suitable headworks at Munnar at a level of 4,750 feet above sea level. The water will then be let through an open channel, where provision is made for arresting silt and sand, and then taken through a tunnel 10,255 feet long bored through the mountains. From the tunnel, at the exit of which a surge shaft will be constructed, the water will be taken to the Power House by two penstocks each 7,447 ft. in length, the Power House level being 2,760 ft.

The present programme is for the development of 9,000 K. W. which could eventually be raised to 30,000 K. W. by the provision of a suitable reservoir. Power generated will be utilized mainly for industrial purposes but it will also be used for irrigation and dewatering of wet lands.

FIVE YEAR PLAN APPROACHES COMPLETION: THE KUT BARRAGE SCHEME. February 25, 1938.

States that in 1931 three big irrigation projects were drawn up by the Iraq Government and passed into law under a five year plan.

One of these is the Abu Ghuraib Canal scheme which is now in process of construction and which aims to be completed during 1938. This canal takes off from the left bank of the Euphrates and is 40 miles long. It is hoped that about 120,000 acres will benefit from this.

The second scheme is that of the Habbaniyah Escape which has not yet been undertaken although the ground was surveyed and marked out for channels some years ago.

The third and the most important is the Kut Barrage Scheme. This provides for a head regulator up-river and a canal along which it will be possible to divert the waters of the Tigris into the Shatt-al-Gharraf. This canal will be about 1¼ miles long and 90 yards wide. The head regulator will control the water flowing from Kut into the Gharraf area. It contains a navigation lock similar to that at Kut. The Barrage at Kut which is now nearing completion is almost 2,000 ft. long including approaches and about 50 ft. high, and contains 56 sluice gates and the great navigation lock which is 50 ft. wide and 260 ft. long. The object of the Barrage is to regulate the vast volume of water running to waste in the flood season and to ensure a regular supply all the year round.

The New Dartford Tunnel: "Cockney Miners" at Work. February 25, 1938.

Gives some particulars about the Dartford Tunnel under the Thames.

New Bridge Across the Severn: Constructional Details. February 25, 1938.

This is an article by A. P. Mason, B.Sc., A.M.I.C.E., M.I.Struct. E. It gives a description of the constructional details with reference to the difficulties encountered due to the river being liable to sudden floods bringing down heavy debris which would make the use of falsework supported in the river bed hazardous and expensive. This bridge contains a river span of 150 ft. and two shore spans of 60 ft. The bridge was constructed by cantilevering consecutive sections from each bank until the gap became small enough to close in one operation.

"Hydel" Coined in India. February 25, 1938.

The word "hydel" has been introduced in the U. P. as a contraction for "hydro-electric scheme" by Sir William Stampe, and is now in common use.

The Lloyd Barrage System: An Irrigation Engineering Marvel. February 25, 1938.

A review of the completion report of the Lloyd Barrage Project in Sind (India), giving the salient features of the system. This scheme is one of the largest irrigation schemes in the world and stands as an irrigation marvel both as regards magnitude and engineering skill. (For detailed notes see on page 113 of Bulletin No. 8.)

A Major Engineering Project: Details of the Ganges Grid Scheme. February 25, 1938.

Describes the origin, development and features of the Ganges Canal Hydro-Electric Grid Scheme recently completed in the United Provinces.

The Haweswater Dam: Gigantic Lake District Project Viewed by Camera. February 25, 1938.

Gives some photographs of the Haweswater Dam, near Manchester, England, This dam is 1,550 ft. long, 120 ft. high and 112 ft. thick and has a storage capacity of 18,400 million gallons.

Tungabhadra Project: Cost Estimated at Rs. 3¾ Crores. February 26, 1938.

States that in replying to Prof. Ranga's question. Mr. Clow said that the cost of the headworks of the Tungabhadra irrigation project was estimated at nearly 3¾ crores, to be shared equally between the Governments of Madras and Hyderabad, the cost of canals in British India estimated at about Rs. 8¼ crores, to be borne by the Madras Government.

Floods and Crops. (Current Topics). March 1, 1938.

Editor's comment on the reply of the Revenue Minister, Assam, to a question regarding damage of crops by floods. The reply was that the Government were aware of the floods but not of the damage done thereby to crops.

Forests in Punjab: Campaign Against Erosion: Administration Report. March 1, 1938.

Review of the annual report on forest administration in the Punjab for 1936-37. It shows that satisfactory progress was continued for the preparation of a working plan for regeneration and afforestation and for the intensification of the campaign against erosion and denudation.

India's Highest Dam: Wilson Reservoir: Project which Wiped out Famine. March 5, 1938.

This is an " unofficial note " issued by the Director of Public Information, Government of India. For notes see under Government of India Publications in the Literature Section of this Bulletin.

The Punjab Budget. (Editorial Note). March 5, 1938.

States that although there was a deficit of Rs. 16¼ lakhs in the budget estimate of 1936-37, the revised figures showed a net saving of Rs. 39¼ lakhs for there was a net improvement in revenue of 42½ lakhs, chiefly from irrigation receipts, and an excess under expenditure of Rs. 3 lakhs. This saving enabled the Government to finance the early stages of the Haveli Irrigation Project.

WINDMILL IRRIGATION: MAY BANISH THE SPECTRE OF FAMINE FROM DECCAN: CONGRESS GOVERNMENT'S EXPERIMENTS. March 6, 1938.

This is an article by " Aeolus " giving a brief history of windmill irrigation, experiments conducted in India, possibility of its introduction in areas which have a wind velocity of six miles or more per hour particularly in the Deccan where wind velocity is favourable, cost of erection and maintenance, etc.

FLOOD CONTROL IN ORISSA: CAREFUL DATA AS FIRST STEP: REPORT BY SIR M. VISVESVARAYA. March 7, 1938.

Review of Sir M. Visvesvaraya's report on the flood problems of Orissa. For notes regarding the report see under Bihar and Orissa Government publications in the Literature section of this Bulletin.

HYDRO-DYNAMIC RESEARCH STATION: SOME VALUABLE CONTRIBUTIONS TO ENGINEERING. March 9, 1938.

Gives briefly the work being done at the Central Irrigation and Hydrodynamic Research Station at Poona, and the importance of such research work to engineering.

SOIL SATURATION: INVESTIGATIONS IN PROGRESS IN PUNJAB AND U. P. March 11, 1938.

States that it is understood that important results are expected from investigations now in progress in the Punjab, U. P. and Sind on the problem of waterlogging which subject was also discussed by the Central Board of Irrigation.

TRAINING OF RIVERS. March 11, 1938.

Editorial remarks on Sir M. Visveswaraya's Report on the Flood problem in Orissa.

PROBLEM OF WATERLOGGING: DISCUSSION BY CENTRAL BOARD OF IRRIGATION. March 11, 1938.

Same as article headed " Soil Saturation " mentioned above.

SIR BERNARD DARLEY. March 12, 1938.

States that it is understood that Sir Bernard Darley, a former Chief Engineer of the United Provinces Government and of the Bahawalpur State, has taken over the duties of honorary representative of the Central Board of Irrigation on the International Commission of Large Dams. The Central Board of Irrigation constitutes the National Committee for British India.

CONSERVING PUNJAB WATER SUPPLIES: THE FIRST STAGES. March 13, 1938.

This is an article by Dr. R. Maclagan Gorrie of the Indian Forest Service. He describes the difference between normal geological erosion and man-made erosion, the result of this man-made erosion (which is chiefly due to the destruction or alteration of the natural plant cover) on water-supplies and silting of rivers, and the measures that should be taken to combat this man-made erosion.

SIND ASSEMBLY: IRRIGATION IN SIND: CUT MOTION LOST. March 14, 1938.

In the Sind Assembly, the speakers on the cut motion under the demand for irrigation urged the Government to approach the Central Government for writing off the barrage debt which aggregates to Rs. 25,01,00,000. The motion was defeated.

TUNGABHADRA SCHEME: EFFORTS TO EXPEDITE PROJECT. March 15, 1938.

It was announced in the Madras Assembly that the Government is making efforts to expedite negotiations with the Hyderabad State regarding Tungabhadra Project. It is understood that a conference between the representatives of the two Governments is likely to be held shortly.

TUNGABHADRA PROJECT. March 16, 1938.

Same as above.

DESERTS BECOME GARDENS: IRRIGATION FEAT: SUCCESS OF PUNJAB PROJECT. March 18, 1938.

This is an " Unofficial note " issued by the Director of Public Information, Government of India, regarding the Triple Canals Project comprising Upper Jhelum, Upper Chenab and Lower Bari Doab Canals. For further particulars see under Government of India publications in this Bulletin.

CALCUTTA LETTER: AGRARIAN AGITATION IN BENGAL: DAMODAR CANAL WATER LEVY. March 18, 1938.

States that on the continued agitation of agriculturists of the Burdwan and Hughli districts the Bengal Government has appointed a committee to enquire about water rates on the Damodar Canal. Commenting on this it is stated that firstly the committee is weakly consituted, secondly Eden canal has been precluded from the terms of reference of the committee and thirdly the rates understood to be proposed by the committee are still high.

BOMBAY ASSEMBLY: IRRIGATION IN BOMBAY: PROVISION FOR NEW SCHEMES. March 18, 1938.

The entire bloc of the Opposition in the Bombay Assembly voted against a demand of Rs. 12,50,000 for various schemes of irrigation on the ground that there were no definite schemes before the Government at present and that when such schemes come up a supplementary grant can be asked for by the Government.

In reply to a question the Minister for Public Works stated that the Government had under consideration the question of giving water of the Godavari river to the Nizam's Government.

CROPS WORTH CRORES IN " BALD UPLAND ": THE TRIPLE CANALS: IRRIGATION MARVEL IN THE PUNJAB. March 19, 1938.

An " Unofficial note " on the Triple Canals Project in the Punjab. See under Government of India publications in this Bulletin.

MORE COTTON CULTIVATED: INCREASE IN WHEAT YIELD: SEQUEL TO BARRAGE CANAL WORKING. March, 19, 1938.

Gives the reports on the sixth year's working of the Sukkur Barrage as furnished by Mr. A. Gordon, Chief Engineer in Sind, to the Indian Roads and Transport Development Association. Figures of wheat and cotton cultivation are given.

WATER-PROOFING CANALS: POSSIBLE NEW USE FOR MOLASSES. March 20, 1938.

Experiments are being conducted in the United Provinces to ascertain if molasses can be utilized to line canals and thereby prevent seepage and waterlogging. Laboratory experiments are understood to have given very satisfactory results and it is now proposed to extend them to the field.

CURRENT TOPICS: MODERN WINDMILL PUMPS. March 20, 1938.

Editorial note on the article on windmill irrigation by " Aeolus " mentioned above under the cuttings of March 6. States that a 16-foot " Aermotor " windmill pump can be obtained for about Rs. 1,300 (*i.e.* Rs. 200 less than the cost given by " Aeolus ") and that the only recurring charges for the first few years should be for the filling of the gear box with good motor lubricating oil, an item which should not exceed Rs. 2 a month at the outside.

CROPS WORTH CRORES: CANALS HAVE TRANSFORMED " BALD UPLAND ". March 20, 1938.

See similar article, dated March 19, 1938.

Better Farming Comes to Sind's Barrage Lands: Business Methods in Agriculture Yield Good Profits. March 20, 1938.

States that a number of business companies, chiefly European, that have taken up farming, have, by the application of commonsense business methods in raising crops and putting them on the market and by making the best use of land and water at their disposal, been successful in increasing agricultural yield.

Also states that a new research station to study the problems of the lands irrigated by the Sukkur Barrage canal system on the right bank of the Indus will soon be opened by the Sind Government at Dokri. For problems of the left bank there already exists a research station at Sakrand.

Erosion Menaces Our Land: Too Much Grazing May Ruin India's Farming. March 20, 1938.

This is an article by a Forest Officer in which are described the dangerous effects of erosion which is caused chiefly by indiscriminate grazing and consequent denudation of the natural forest cover.

Strategic Link: Adozai Bridge over Kabul River. March 21, 1938.

The Adozai Bridge over the Kabul River was opened for traffic on March 19 by Mr. G. M. Ross, C.I.E., Chief Engineer, P. W. D., N.-W. F. P. The bridge is 270 ft. long and replaces the one built in 1930 but whose foundations were washed away. To make sure foundation for the piers of the new bridge, the piles, which are of the "screw-crete" type, have been driven to a depth of over 60 ft. into the river bed which consists mostly of boulders. Each pile has a cast iron screw seven feet in diameter at the bottom.

Sweetened Canals? Possible New Use for Molasses. March 23, 1938.

Same as the article dated March 20.

Deforestation Harm: Effect on Irrigation Projects. March 24, 1938.

States that fertility of silt and effects of deforestation on irrigation water supplies are two new subjects which have been decided upon for investigation by the Central Board of Irrigation during the year 1938-39.

U. P. Assembly: Irrigation in U. P.: Development Plan. March 26, 1938.

A cut under irrigation demand was moved to suggest that the units system of charging irrigation dues on tube-well irrigation should be replaced by the system of fees prevailing in canal-irrigated areas on the plea that the former were higher. Formation of co-operative societies for distribution of water was also suggested. The Minister in charge of irrigation did not agree with the plea that rates under the tube well system were higher than those under the canal irrigation system.

Grid System in Bihar: Special Officer to Inquire. March 26, 1938.

Mr. S. K. P. Sinha has been appointed as special officer to enquire into the possibilities of increased demand for electricity, first for irrigation from tube wells on river beds, secondly for increasing the demand for commercial purposes and thirdly, the best methods of making the available supply of electricity.

Silting Tanks: How to Prevent. March 26, 1938.

In the Mysore Assembly attention of the Government was drawn towards silting up of tanks within a year or two after restoration. The Chief Engineer to Government suggests that the rate of silting can be retarded by developing plantations in the catchments areas of tanks, fencing plants round the water margin, preventing the ploughing of lands near the tank beds, and by constructing earthen or masonry silt dams or small stop tanks across feeder valleys. He further says that one other possible method is the actual scraping out of the silt from the tank bed when it is dry by means of modern tractors and scrapers, and selling the silt removed for manure.

Thames Barrage: Abandonment of Project Announced. March 30, 1938.

M. T. GIBLING,
Secretary,
Central Board of Irrigation.

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